January 2021

Updating a study of the union effect on safety in the ICI construction sector

A report prepared by the Institute for Work & Health for the Ontario Construction Secretariat

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Updating a study of the union effect on safety in the ICI construction sector

A report prepared by the Institute for Work & Health for the Ontario Construction Secretariat

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Executive Summary

The Institute for Work & Health (IWH) has completed a study of the effect of unionization on the incidence of workers' compensation claims in companies from the Institutional, Commercial and Industrial (ICI) construction trade sector in Ontario. Using data from 2012-2018, this research updated an earlier IWH study (Amick et al., 2015), which used data from 2006-2012. The earlier study concluded that unionization lowered the likelihood of organizations reporting lost-time injury claims and increased the likelihood of them reporting no-lost-time injury claims.

Records of companies belonging to the ICI construction trade sector and their corresponding workers' compensation claims records from 2012-2018 were obtained from the Workplace Safety and Insurance Board (WSIB), which administers a single-payer workers' compensation insurance scheme for the province of Ontario. Records of union contractors, provided by the ICI trade unions and employer associations, were used to identify which among the WSIB-registered ICI companies were unionized. A series of negative binomial regression analyses, with and without statistical adjustment for company size, company complexity, industrial sub-sector, and geographical location were carried out.

This study repeated the finding of Amick et al. (2015) that company unionization was associated with a lower risk of lost-time allowed (LTA) injury claims. With an adjusted risk ratio of 0.75 (0.71 – 0.80), unionization was associated with a 25% lower rate of LTA injuries. Also repeated from before were findings that unionization was associated with a lower risk of lost-time claims related to musculoskeletal injuries or to critical (severe) injuries – found to be 23% and 16% lower, respectively. Unadjusted risk ratios indicated unionization was associated with a 31% lower incidence of LTA injury claims, a 25% lower incidence of musculoskeletal LTA injury claims, and a 29% lower incidence of critical LTA injury claims.

The present study did not repeat the earlier finding that unionization was associated with a higher risk of no-lost-time claims in analyses with statistical adjustment. Although results indicated an increased risk of 4%, it was not statistically significant. This difference between studies appears to be partly related to a methodological refinement in the current study, in which five company size categories were used instead of three.

This study extended the earlier study by investigating the union effect in different company size categories. Results from analyses with statistical adjustment indicate that the union effect on LTA claim incidence was greater among the largest companies with 50-plus full-time equivalent employees (FTEs), with a 44% reduction in claim incidence, compared to companies with 5-19 FTEs or 20-49 FTEs, which showed reductions of 25% and 24%, respectively. Notably, no union effect was observed among companies with 0-4 FTEs.

The study also extended the earlier study by estimating the union effect on the incidence of LTA injury claims in seven ICI construction sub-sectors.

Both the present study and the Amick et al. (2015) study have been consistent in finding a favourable union safety effect on injuries requiring time away from work, including both musculoskeletal and critical (more severe) injuries, among companies in the ICI sector. While the cause of this effect is not certain, the association is robust to sensitivity tests, differing time periods, variations in methodology and changes in IWH research team composition. We can conclude with a high degree of confidence that unionization is associated with a lower incidence of workers' compensation lost-time injury claims in companies comprising the ICI sector. However, one cannot assume that this union effect is found in every ICI sub-sector nor that it applies to companies with fewer than five employees.

Introduction

This report documents an Institute for Work & Health (IWH) research study of the effect of unionization on the incidence of workers' compensation claims from 2012 to 2018 in companies from the Institutional, Commercial and Industrial (ICI) construction sector in Ontario. This research updated an earlier IWH study (Amick et al., 2015), which used data from 2006 to 2012. The earlier study concluded that unionization lowered the likelihood of organizations reporting lost-time injury claims and increased the likelihood of them reporting no-lost-time injury claims. Both the Amick et al. (2015) study and the present study were sponsored by the Ontario Construction Secretariat (OCS). OCS is a joint management-labour non-profit organization, formed to represent the interests of the union members and union contractors in the ICI construction sector (OCS, 2020).

Methods in Brief[1]

Records of companies belonging to the ICI construction trade sector[2] and their workers' compensation claims records from 2012-2018 were obtained from the Workplace Safety and Insurance Board (WSIB), which administers a single-payer workers' compensation insurance scheme for the province of Ontario. Records of union contractors, provided by ICI trade unions and employer associations (listed in Appendix B), were used to identify which among the WSIB-registered ICI companies were unionized.

The number of workers' compensation injury claims (various types) and number of full-time equivalent employees (FTEs) for each line of business in the ICI companies were calculated from information in the WSIB records. WSIB categorized each line of

[1] Methods are presented in detail in Appendix A.

[2] ICI trade sector was defined as those companies with their largest line of business, as measured by payroll, classified in one of 39 WSIB classification units considered to be in the ICI trade sector (listed in Appendix E).

business by classification unit (CU),[3] corresponding to a type of construction activity or industrial sub-sector, such as Carpeting & Flooring. The analysis was carried out at the level of company line of business, called company-CU in this document. For most companies, the company and company-CU were the same organizational unit because there was only one line of business. For companies with multiple lines of business, each of its company-CUs was considered separately in the analysis and included only if it belonged to one of the 39 CUs considered to be involved in the ICI construction trades (listed in Appendix E).

The analysis was based on 60,425 company-CUs, from 58,837 companies. Statistical analyses (negative binomial regression) determined whether unionization had an impact on the injury claim rates of company-CUs, while minimizing the influence of geographical region, CU type, company complexity (i.e. number of CUs in the company) and size of company (measured in FTEs). These variables were all based on information in the WSIB records. Six types of injury/illness claims were examined: lost-time allowed (LTA), musculoskeletal LTA, critical (severe) LTA, no-lost-time allowed (NLTA), total allowed, and total allowed and not allowed. LTA claims were of primary interest.

Methods used in the present study replicated those of the Amick et al. (2015) study in their main aspects. However, this study introduced a refinement at the outset because of the high prevalence of firms with fewer than 20 employees in the construction sector. In the Amick et al. study, a three-level categorical variable for company size was used (<20, 20-50 and 50+ FTEs). In the current study, the smallest size category was further divided (into 0-1, 2-4 and 5-19 FTEs), yielding five categories overall. A second modification was the way in which union contractor records missing both a postal code and telephone number were matched to WSIB records. Instead of searching for missing information on the Internet using name, WSIB records were searched directly using name, by applying computer-assisted and manual methods (see Appendix A for more detail).

[3] The WSIB classification scheme changed in 2019 and is now based on the North American Industrial Classification System (NAICS).

Results

Description of the study sample

The sample used in the analysis comprised 60,425 company-CUs, of which 5,267 (8.7%) were classified as unionized and 55,158 (91.3%) as non-unionized, following the matching of WSIB records and the records of unionized contractors (Table 1). The full-time employee equivalents were distributed quite differently, with 45% of FTEs found in unionized company-CUs. The proportion of LTA claims from unionized company-CUs was less than this value (31%), and the proportion of NLTA claims was greater (52%).

Table 1: Numbers of companies, company-CUs, FTEs and claims, unionized and non-unionized, in analytical sample

	Unionized		Non-unionized	
	Number	%	Number	%
Company-CUs	5,267	8.7	55,158	91.3
Companies	4,713	8.0	54,124	92.0
Annual full-time equivalent employees (FTEs), cumulative, 2012-2018	772,797	44.6	958,186	55.4
Lost-time allowed (LTA) claims	5,873	31.0	13,089	69.0
Musculoskeletal LTA claims	1,923	33.3	3,853	66.7
Critical (severe) LTA claims	547	34.3	1,047	65.7
No-lost-time allowed (NLTA) claims	34,904	51.7	32,589	48.3
Total allowed claims (LTA and NLTA)	40,777	47.2	45,678	52.8
Total allowed and not allowed claims	46,843	46.9	52,966	53.1

CU, classification unit

Unionized company-CUs tended to be from larger companies, with relatively greater percentages in the categories of 5-19, 20-49 and 50+ FTEs (Figure 1, top panel). Accordingly, they also tended to be from more complex organizations; i.e. those with more than one CU in the company (Figure 1, bottom panel). A third way in which they differed was the year they registered with WSIB, with unionized company-CUs tending to have been registered longer. Among unionized company-CUs, 59% had registered before 2005 and 17% in 2013 or later. Among non-unionized company-CUs, the corresponding values were 29% and 41%, respectively (see Appendix C).

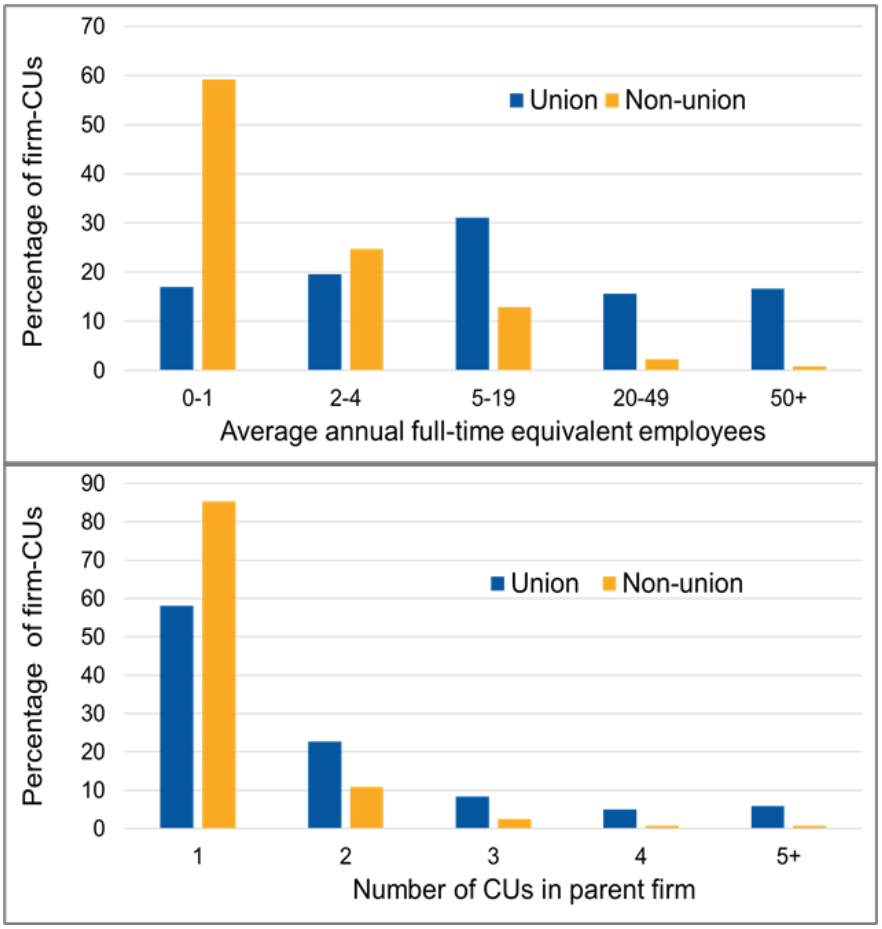

Figure 1: Distribution of unionized (n = 5,267) and non-unionized (n = 55,158) company-CUs in the study sample by i) firm size (annual full-time equivalent employees) and ii) complexity (number of CUs in company)

There were only small differences in the geographical distributions of unionized and non-unionized company-CUs (see Appendix D). The distributions across CU type were also quite similar, with occasional exceptions; the four CUs of Painting & Decorating, Carpeting & Flooring, Terrazzo & Tile Work and Roof Shingling were three to seven times more common among non-unionized than unionized company-CUs (see Appendix E).

Estimation of union effect

Table 2 presents the main findings from a series of regression analyses. They are presented as risk ratios, which is the ratio of the risk of injury claims in unionized company-CUs to the risk in non-unionized company-CUs. A risk ratio value between 0 and 1 indicates a lower risk for unionized company-CUs. The *crude risk ratios (or unadjusted risk ratios)* provide a simple comparison of risk in unionized and non-unionized company-CUs. This report focuses on the *adjusted risk ratios*, since these estimate the singular effect of unionization, independent of other factors. These ratios are based on analyses (i.e. regression models) that 'control for' or minimize the influence of other differences between unionized and non-unionized companies that may account for differing numbers of claims, including company size, company complexity, type of construction work (CU category) and geographical region. Of these four variables, company size was found to be the most influential on the estimation of union effect and, therefore, the most important to include in models.

Table 2 shows unionization had a statistically significant effect on the risk of LTA claims in company-CUs, as well as on two sub-categories of LTA claims. That is, unionization was associated with a 25% lower incidence of LTA injury claims, a 23% lower incidence of musculoskeletal LTA injury claims, and a 16% lower incidence of critical (more severe) LTA injury claims. Adjusted risk ratios and confidence intervals (in brackets) were 0.75 (0.71 – 0.80), 0.77 (0.70 – 0.85) and 0.84 (0.73 – 0.96), respectively. [Statistical significance is indicated when the confidence interval does not contain the value of 1.00.] In analyses without statistical adjustment, unionization was associated with a 31% lower incidence of LTA injury claims, a 25% lower incidence of musculoskeletal LTA injury claims, and a 29% lower incidence of critical LTA injury claims (see unadjusted risk ratios).

In contrast, for NLTA claims, the adjusted risk ratio was 1.04 (0.98 – 1.09), indicating a small, statistically *non*-significant union effect, increasing the incidence of NLTA

injury claims by 4%. The union effect was also determined for two types of total claims. For total allowed claims (LTA and NLTA combined), a small significant union effect of decreasing the rate of injury claim by 5% was found – 0.95 (0.91 – 0.99). For total allowed and not allowed claims, no effect was found – 0.98 (0.94 – 1.03). Not-allowed claims included those that were pending, abandoned or denied.

Table 2: Union safety effects (risk ratios) estimated from statistical modeling[a] of cumulative WSIB claim counts, 2012-2018, in company-CUs

WSIB claim type	Crude risk ratio[b] (95% CI)[c]	Adjusted risk ratio (95% CI)
Lost-time allowed	**0.69** (0.65 – 0.74)	**0.75** (0.71 – 0.80)
Musculoskeletal	**0.75** (0.69 – 0.82)	**0.77** (0.70 – 0.85)
Critical (severe)	**0.71** (0.63 – 0.80)	**0.84** (0.73 – 0.96)
No-lost-time allowed	**1.80** (1.71 – 1.89)	1.04 (0.98 – 1.09)
Total allowed	**1.40** (1.34 – 1.46)	**0.95** (0.91 – 0.99)
Total allowed and not allowed	**1.41** (1.35 – 1.47)	0.98 (0.94 – 1.03)

[a] Negative binomial modeling with outcomes of cumulative claim counts, 2012-18, and log (full-time equivalent employees) as the offset variable. Sample size: 5,267 unionized and 55,158 non-unionized company-CUs. Models were developed separately for each outcome. Unionization (binary) was the main independent variable in all models. In adjusted models, categorical variables for company size, complexity, classification unit type and geographical region were also included, as detailed in Appendix A. Regression results are presented in full in Appendix F.

[b] Risk ratio is the ratio of the risk of injury claims in unionized company-CUs to the risk of injury claims in non-unionized company-CUs. Crude risk ratio is from models with union as the sole independent variable. Adjusted risk ratio is from models with additional variables (see table footnote a) to minimize their effect on the estimation of the union effect. Statistically significant risk ratios are shown in boldface.

[c] 95% CI; i.e. 95% confidence interval, the range in which the true value of union effect likely lies. Results are statistically significant by conventional standards ($\alpha = 0.05$) when the confidence interval does not encompass the value 1.

Union effect by company size

After dividing the study sample of company-CUs into four groups, according to the number of FTEs in their respective companies, analyses with LTA injury claims were carried out separately for each group. Results in Table 3 show that the union effect differed by company size. The effect was greatest in companies with annual FTEs of

50 or more, with an adjusted risk ratio of 0.56 (0.48 – 0.66); that is, unionization was associated with a 44% lower LTA claim incidence. Results for companies with 5-19 FTEs and 20-49 FTEs were similar: unionization was associated with a lower LTA claim incidence of 25% and 24%, respectively. For companies with 0-4 FTEs, no union effect was observed.

Table 3: Union safety effects (risk ratios) estimated from statistical modeling[a] of cumulative LTA injury claims, 2012-2018, in company-CUs – by company size

Company size[b]	Number of company-CUs	Crude risk ratio[c] (95% CI)[d]	Adjusted risk ratio (95% CI)
0-4 FTEs	48,186	0.91 (0.78 – 1.06)	0.98 (0.84 – 1.15)
5-19 FTEs	8,740	**0.75** (0.68 – 0.83)	**0.75** (0.69 – 0.83)
20-49 FTEs	2,092	**0.79** (0.70 – 0.89)	**0.76** (0.67 – 0.86)
50+ FTEs	1,319	**0.64** (0.55 – 0.74)	**0.56** (0.48 – 0.66)

[a] Negative binomial modeling with outcomes of cumulative claim counts, 2012-18, and log (full-time equivalent employees) as the offset variable. Models were developed separately for each company size. Unionization (binary) was the main independent variable in all models. In adjusted models, complexity, classification unit type and geographical region were also included as independent variables, as detailed in Appendix A. Regression results are presented in full in Appendix G.

[b] Company size is average annual number of full-time equivalent employees (FTEs).

[c] Risk ratio is the ratio of the risk of injury claims in unionized company-CUs to the risk of injury claims in non-unionized company-CUs. Crude risk ratio is from models with union as the sole independent variable. Adjusted risk ratio is from models with additional variables (see table footnote a) to remove their effect on the estimation of the union effect.

[d] 95% CI; i.e. 95% confidence interval, the range in which the true value of union effect likely lies. Results are statistically significant by conventional standards ($\alpha = 0.05$) when the confidence interval does not encompass the value 1.

Union effect by WSIB classification unit (ICI sub-sector)

Separate analyses were carried out with LTA injury claims for different CUs, in order to provide sector-specific results and to explore the variation in union effect across CUs. Reported in Table 4 are the results for seven CUs. These met a precision requirement, decided upon beforehand, that their adjusted risk ratio needed to have a confidence interval of 0.5 or less. Union effects derived from adjusted models

varied from an 18% lower LTA injury claim incidence to a 72% lower incidence, across the seven CUs. These results were statistically significant for all but one CU.

Table 4: Union safety effects (risk ratios) estimated from statistical modeling[a] of cumulative LTA injury claims, 2012-2018, in company-CUs – for selected CUs

Classification unit title	Number of company-CUs	Crude risk ratio[c] (95% CI)[d]	Adjusted risk ratio (95% CI)
Electrical Work	8958	**0.74** (0.64 – 0.86)	**0.75** (0.64 – 0.88)
Excavating and Grading	2676	**0.64** (0.49 – 0.83)	**0.69** (0.52 – 0.92)
Industrial Maintenance & Repair Contracting	732	**0.30** (0.16 – 0.56)	**0.28** (0.14 – 0.57)
Industrial, Commercial & Institutional Construction	3416	**0.71** (0.57 – 0.88)	0.82 (0.66 – 1.02)
Millwright & Rigging Work	739	**0.33** (0.23 – 0.47)	**0.33** (0.22 – 0.50)
Plumbing, Heating & Air Conditioning, Installation	9614	**0.58** (0.51 – 0.66)	**0.63** (0.55 – 0.72)
Sheet Metal & Built-Up Roofing	639	**0.42** (0.30 – 0.59)	**0.48** (0.33 – 0.71)

[a] Negative binomial modeling with outcomes of cumulative claim counts, 2012-18, and log (full-time equivalent employees) as the offset variable. Models were developed separately for each CU. Unionization (binary) was the main independent variable in all models. In adjusted models, firm size, complexity and geographical region were also included as independent variables, as detailed in Appendix A. Regression results are presented in full in Appendix H.

[b] Risk ratio is the ratio of the risk of injury claims in unionized company-CUs to the risk of injury claims in non-unionized company-CUs. Crude risk ratio is from models with union as the sole independent variable. Adjusted risk ratio is from models with additional variables (see table footnote a) to remove their effect on the estimation of the union effect.

[c] 95% CI; i.e. 95% confidence interval, the range in which the true value of union effect likely lies. Results are statistically significant by conventional standards ($\alpha = 0.05$) when the confidence interval does not encompass the value 1.

Sensitivity analyses

To explore the robustness of the union effect, several sensitivity analyses were conducted with LTA claims. The first of these involved an expansion of the WSIB

companies classified as unionized. In the main analysis, a WSIB record was classified as unionized if it matched a union contractor record on at least two of name, postal code and telephone number (strong matches). In the expanded analysis, additional WSIB records were classified as unionized, on the basis of matching name only (weak matches), either because of missing postal code and telephone number or because of a mismatch of information. This reclassification expanded the number of company-CUs classified as unionized from 5,267 to 6,224 among the total 60,425 company-CUs. The expansion resulted in a small reduction in the union effect for LTA injury claims, from 25% to 23% (Table 5). The effects on critical (severe) LTA injury and NLTA claims were similarly modest.

Table 5: Results of sensitivity analysis with an expanded definition of unionization

WSIB claim type and number of unionized company-CUs in analysis	Crude risk ratio (95% CI)	Adjusted risk ratio (95% CI)
Lost-time allowed (LTA)		
Main analysis, n = 5267	**0.69** (0.65 – 0.74)	**0.75** (0.71 – 0.80)
Expanded union definition, n = 6224	**0.72** (0.68 – 0.76)	**0.77** (0.72 – 0.81)
Critical (severe) LTA		
Main analysis, n = 5267	**0.71** (0.63 – 0.80)	**0.84** (0.73 – 0.96)
Expanded union definition, n = 6224	**0.72** (0.64 – 0.82)	**0.86** (0.74 – 0.98)
No-lost-time allowed		
Main analysis, n = 5267	**1.80** (1.71 – 1.89)	1.04 (0.98 – 1.09)
Expanded union definition, n = 6224	**1.77** (1.69 – 1.85)	1.05 (1.00 – 1.10)

Total number of company-CUs in the regressions was n = 60,425, with the exception of the NLTA injury claims with the expanded union definition (n = 60,424), in which a single outlier was removed to achieve model convergence. Expanded union definition refers to expanding the set of WSIB companies classified as unionized by the inclusion of those matched to union contractor records on company name but not with postal code or telephone number (i.e. with the addition of weak matches). See Appendix A for more detail.

A second sensitivity analysis addressed the fact that classification as unionized took place at the level of company, rather than company-CU, the unit of analysis. For any company that had some company-CUs unionized and others not, the latter group

might have been misclassified as unionized. To address this concern, the analysis was restricted to companies consisting of only one CU, reducing the number in the analysis to 50,096. This decreased the union effect to 18%, but it remained statistically significant (adjusted risk ratio 0.82 (0.75 – 0.89).

A third analysis addressed the possible lack of alignment between the ICI trade sector based on WSIB administrative categories and the sources of unionization information. Specifically, there was a recognition that some of the companies belonging to any of the 39 WSIB CUs designated here to be within the ICI construction trade sector might, in reality, work part of the time or even solely in civil construction or homebuilding construction; yet lists of union contractors from these latter sectors were not used to identify WSIB records as unionized. That means some unionized companies could have been misclassified as non-unionized. For this sensitivity analysis, only company-CUs belonging to one of seven CUs were used. Based on descriptions in WSIB documentation, these seven CUs appeared to encompass companies working only in the broader ICI sector: Industrial, Commercial & Institutional Construction, Heavy Engineering Construction, Millwright & Rigging Work, Form Work (High Rise), Structural Steel Erection, Painting of Structures, Precast Concrete Installation, and Other Structural Work. The number of company-CUs for this analysis was relatively small (4,873) and resulted in an increase in the union effect for LTA injury claims to 29%; that is, a risk ratio of 0.71 (0.60 – 0.84).

The final sensitivity analysis explored the impact of changing the five-category company size variable used in the present study to the three-category one used in the Amick et al. (2015) study. Regressions were rerun with the current data set using the three-category approach. This had almost no impact on the estimated union effect on LTA claim incidence rate, changing it from a 25% decrease to a 24% decrease. In contrast, for NLTA claim incidence rates, the union effect went from being a statistically non-significant 4% increase to being a statistically significant 16% increase.

Discussion

Principal findings and comparison with earlier study

This study update repeated the finding of Amick et al. (2015) that company unionization is associated with a lower risk of LTA injury claims. With an adjusted risk ratio of 0.75 (0.71 – 0.80), company unionization was associated with a 25% lower incidence of LTA injury claims. Also repeated from the previous study were findings that unionization was associated with lower risks of lost-time claims related to musculoskeletal injuries or to critical (severe) injuries – found to be 23% and 16% lower, respectively. This study adds confidence to the finding about critical injuries, because the finding is based on a fully adjusted regression model, whereas, for technical reasons, the finding in the earlier study was based on a partially adjusted model.

The present study did not repeat the earlier finding that unionization was associated with a higher risk of no-lost-time claims. Although results indicated a higher risk of 4%, it was not statistically significant. This difference appears to be partly related to a refinement in the current study, which used a finer categorization of company size in regression models (five categories instead of three). When the three company size categories used in the old study were applied to the 2012-18 data set in regression analysis, then the earlier finding of a statistically significant increased risk of NLTA injury claims was repeated, with an adjusted risk ratio of 1.16 (1.10 – 1.22).

Amick et al. (2015) reported a union versus non-union effect of 14% lower LTA injury claim rate, with an adjusted risk ratio of 0.86 (0.82 – 0.98). When the 2006-2012 data from that study were reanalyzed using the current study's five company size categories, the union effect was lowered to 8%, with an adjusted risk ratio of 0.92 (0.87 – 0.97). The corresponding value in this study was 25%, with an adjusted risk ratio of 0.75 (0.71 – 0.80), suggesting the union effect has increased over time. We are cautious in our interpretation of this observation, since this study was not designed to measure change over time, nor to identify mechanisms of change. Of particular concern is the turnover of companies between the two time periods, including a large influx of newly registered companies in 2013-15 as a result of a

change in mandatory coverage by WSIB.[4] By comparing the excess numbers of company-CUs from companies registered in those years to those registered in 2012 (see Appendix C), we estimate that 2% of the unionized sample and 16% of the non-unionized sample were registrants arising from the regulatory change.

This study extends the earlier study by investigating the union effect in different company size categories. Results indicate that the union effect on LTA injury claim incidence was greater among the largest companies (50+ FTEs), with a 44% reduction in LTA injury claim rate, compared with companies with 5-19 FTEs or 20-49 FTEs, which showed reductions of 25% and 24%, respectively. Notably, no union effect was observed among the very smallest companies (0-4 FTEs).

The study also extends the earlier study by providing estimates for seven of the 39 CUs in the study. Variation was found among them, but all showed a favourable union effect on lost-time claim incidence.

Study strengths and limitations

A strength of the present study was the availability of a single comprehensive source of workers' compensation administrative data, with several variables useful for covariate control in multivariable regression analysis. The sample size yielded relatively precise estimates of union effects for the ICI sector as a whole and for seven sub-sectors.

Lists of unionized contractors were sourced from unions and employer associations to cover all ICI trades represented in the 39 WSIB ICI classification units. However, for several trades (Boilermakers, Millwrights, Refrigeration Workers, Sheet Metal Workers and Roofers), only employer association lists were available, which are believed to be less complete than union lists. This could result in some unionized companies being classified as non-unionized in some CUs. However, this problem should be limited in scale, since lists corresponding to the six largest CUs, which together account for 48% of company-CUs, came from union sources.

[4] As of 2013, sole operators in construction sector were required to register with WSIB for the first time. A separate descriptive analysis suggests an increase was seen in all firm size categories to some extent.

Even when lists of unionized contractors were complete, companies might not have been matched to WSIB records if information was missing (an issue in some lists) or if it was recorded differently. One way to check the completeness of the record matching was to compare the study estimate of 45% unionization of the ICI workforce to the estimate of 32% for construction as a whole (Statistics Canada, 2020). As expected, the percentage was greater for the more highly unionized ICI sector. Even so, 72% of the union contractor records remained unmatched to the WSIB data after the five linkage steps had been completed, suggesting a large number of WSIB records may have been classified wrongly as non-unionized rather than unionized. An in-depth manual investigation of a sample of 200 of these records was therefore carried out (see Appendix A). Its findings suggest this potential misclassification is not a major threat to the validity of the results. Of the 55,158 company-CUs classified as non-unionized, the investigation estimated that 395 may have actually been unionized, increasing the total unionized from 5,267 to 5,662 and decreasing the total non-unionized to 54,763. This magnitude of change in classification is unlikely to modify results in a substantial way, given the robustness of the union estimate in the sensitivity analyses. In particular, we note that the estimated effects showed little change when the definition of unionized was loosened in a sensitivity analysis to expand the group of companies classified as unionized from 5,267 to 6,224.

A common concern with using workers' compensation data is its underestimation of the true incidence of work-related injury due to under-reporting. We were not able to estimate the impact of this bias in the present study. However, it would be expected to result in an underestimation of the true union effect, since unionization is associated with a greater likelihood of reporting workers' compensation claims (Barnetson et al., 2018; Stock et al., 2014). On the other hand, there could be an overestimation of the union effect arising from the way in which WSIB imputes an employer's FTEs by dividing reported payroll by the average wage among all lost-time claimants in the employer's rate group.[5] When, in a rate group, the wage of the average worker from a unionized employer with a lost time claim is higher than the

[5] At the time of the study, rate group was an industrial classification one level higher than classification unit. The 39 CUs considered to be involved in ICI trades, were nested in 11 rate groups.

wage of the average worker from a non-unionized employer, then the FTEs of unionized employers will be overestimated by the WSIB imputation and the corresponding injury claim rate underestimated; for non-unionized employers, FTEs will be underestimated and claim rate overestimated. Although this may affect estimates of the union effect, it is unlikely to explain all of it. This study showed that the union effect increased with firm size, whereas we find the wage differentials between unionized and non-unionized trade workers is either constant or decreases with firm size (see Appendix I).

Results from the study are limited to the ICI sector as a whole. They cannot be generalized to every sub-sector, since only seven CUs were separately examined. Although all seven union effect estimates indicated a lower rate for unionized companies, the variation in the magnitude of the effect was substantial. As well, the results from this study about the union effect in the ICI sector cannot be generalized to construction sectors outside of the ICI sector.

The study was not able to identify the reasons for the union effect on lost-time injuries.

Explanations for the union effect

Various suggestions have been offered by researchers and Ontario stakeholders for the union effect on LTA injury claim incidence. It could be related to more or better occupational health and safety (OHS) training leading to safer working conditions and more knowledgeable workers. With training and union backing, unionized workers could be more empowered to report on unsafe conditions, refuse unsafe work and ensure enforcement when needed. Non-OHS factors may also be related to both unionization and having an impact on injury risk, including a higher journeyman-to-apprentice ratio, less worker turnover and longer job tenure. The last has been shown to affect injury risk markedly (Morassaei et al., 2013). There continues to be few research contributions elucidating the mechanisms involved in the union effect.

Another factor to be considered is return-to-work programs, which are more likely to be available in larger, companies than in smaller ones, and larger companies are more likely to be unionized. With such programs, injured workers may be able to return to work right away on light duty and, as a result, not file a lost-time injury claim, though perhaps a no-lost-time injury claim instead. This potential threat to the

validity of the results is partly addressed by finding a significant, albeit smaller, union effect with critical injury claims. These would necessitate time away from work, even in the presence of return-to-work programs, because of their severity (injuries jeopardizing life, amputations, etc.).

Because of the multivariable regression approach undertaken in this study, it is very unlikely that the observed union effects could be explained by union versus non-union differences in company size, company complexity, CU profile or geography. We were not able to control for company age, but inclusion of a proxy, a three-category variable, based on the year of initial registration with WSIB (2004 or earlier, 2005-2012, 2013-2018), in a supplemental analysis of LTA injury claims, showed no change in the estimate of union safety effect. We also did not control for any demographic differences between the workforces, such as average length of job tenure. While this variable is not available for all workers in the company-CUs included in the analysis, it is available for those workers who filed workers' compensation claims. We suggest that future studies of this nature explore the inclusion of such a variable.

Any explanation for the union effect in the Ontario ICI context must account for the observation that no union effect was found in companies with 0-4 FTEs. It may be that, in this sub-group of companies, factors related to small company size override any union effect. These factors could be a lack of OHS expertise, younger company age or lower average job tenure. As well, in Ontario, OHS regulatory requirements differ for companies in this smallest size category and those in the next largest category, 5-19 FTEs. These differences include requirements for those in the 5-19 FTEs to post OHS policies, to have a health and safety representative, and to have a supervisor onsite. Further attention to this finding is warranted.

Conclusion

Both the present study and the Amick et al. (2015) study were consistent in finding a favourable union safety effect on injuries requiring time away from work, including both musculoskeletal and critical (more severe) injuries, among companies in Ontario's ICI sector. While the cause of this effect is not certain, the association is robust to sensitivity tests, differing time periods, variations in methodology and changes in IWH research team composition. We can conclude with a high degree of confidence that unionization is associated with lower workers' compensation lost-time injury claim rates among companies comprising Ontario's ICI sector. However, one cannot assume that this union effect is found in every ICI sub-sector or that it applies to companies with fewer than five employees.

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Appendices

Appendix A: Methods in detail

Data sources

Workers' compensation records

Two types of records were obtained from Ontario's Workplace Safety and Insurance Board – deidentified worker claim records and company account records. The WSIB is a provincial agency administering the province's single-payer no-fault workers' compensation scheme, under which all workers in the construction sector are covered. Since 2013, that includes self-employed construction workers. Workers are insured for work-related traumatic injuries and physical illnesses. Since 2018, they are also insured for chronic stress.

Worker claim record information included the date of injury/illness occurrence, the employer, the employer's classification unit to which the worker belonged at the time of the incident, and whether the claim was allowed or not allowed. The 'not allowed' category included claims that were pending, abandoned or denied. Allowed claims were of two types: lost-time allowed (LTA) claims, for which time was lost from work, and no-lost-time allowed (NLTA) claims. LTA claims were coded according to a national Canadian standard, CSA Z795, with respect to nature of the injury, part of body injured and nature of the event.

Employer account information included annual information on legal company name, trade name (optional), address, postal code, phone number, industrial sub-sector (rate group), a finer-level categorization of sub-sector (classification unit or CU[6]), payroll and number of full-time equivalent employees (FTEs) imputed from payroll. Some accounts included more than one CU, so CU-level FTE information was also obtained.

[6] Classification unit was used during the time of the study. In 2019 WSIB adopted NAICS categories instead.

Union contractor records

Twenty-four lists of ICI companies employing unionized construction trade workers were obtained from the Ontario Construction Secretariat, which collected them from unions and employer associations; one union provided a list to IWH directly. The lists came from 11 unions and 13 employer associations (see Appendix B). Lists always contained names and, to varying degrees, addresses, postal codes and phone numbers. For any given ICI trade, a union list was preferred to an employer association list, because payments to the union depend on tracking of contracts with companies. In contrast, membership in an employer association is voluntary and might not include all contractors in the sector. Sometimes both union and employer association lists were available. For Boilermakers, Millwrights, Refrigeration Workers, Sheet Metal Workers, and Roofers, only employer association lists were available. Across all lists, there were 25,772 records in total, of which 22% were missing both the phone number and postal code, 9% were missing the phone number only, and 7% were missing the postal code only.

Study sample

The initial sample of 107,939 WSIB employer records included all companies for which the largest payroll component, for at least one of the years between 2012-2018, was classified into one of the 39 CUs identified by OCS as involving ICI construction trades (see Appendix E). These employers comprised 123,224 unique company-CUs and 515,205 company-CU-years.

Exclusion criteria were then applied: 1) exclusion of company-CU-year if CU was not one of the 39 ICI trade CUs (resulting in 11,8068 fewer company-CUs and 42,893 fewer company-CU-years); 2) exclusion of company-CU-year if annual FTE information was missing (resulting in 2,091 fewer company-CUs and 4,710 fewer company-CU-years); and 3) exclusion of company-CU-year if corresponding cumulative company-CU for 2012-2018 was ≤1 FTE (resulting in 50,189 fewer company-CUs and 143,066 fewer company-CU-years).

The final sample used in regression analysis consisted of 60,425 unique company-CUs, the unit of analysis. These corresponded to 58,837 unique companies and 324,536 company-CU-years.

Record linkage to identify unionized companies

To identify which of the 107,939 companies in the initial sample of WSIB employer records were unionized, the companies were linked (matched) to union contractor records using three variables: name, postal code (PC) and phone number (PN). If a WSIB company record was matched to a union contractor record, the WSIB record was classified by researchers as unionized; if not matched, it was classified as non-unionized.

Matches were considered *strong* and included in the main analysis if at least two of three variables were matched (with the third either missing from one or both records, or mismatched). Matches were considered *weak* and included only in a sensitivity analysis if only the name was matched. Since there were sometimes changes over time in a company's name, PC or PN, all unique combinations of the three were used in matching.

Five sequential linkage steps were used, with the first three producing strong matches and the last two producing weak matches:

1) Linkage on PC and PN
2) Linkage on PN and edited name (using SPEDIS scores)
3) Linkage on PC and edited name (using SPEDIS scores)
4) Linkage on edited name (exact matches with COMPGED scores)
5) Linkage on original name, using text mining

If WSIB and union contractor records were linked in a step, they were removed from the pool of records used in the subsequent step.

The SAS statistical software function MERGE was used to match PNs and/or PCs in Steps 1 through 3, so exact matches were automatically found. Matching on company names in Steps 2 through 4 used "fuzzy-matching" methods (Roesch, 2012; Salas et al., 2018; Sloan and Lafler, 2018) to deal with the various discrepant ways an organization can be documented in different data sources (e.g. Rob's Plumbing vs. Rob's Plumbing Inc.). WSIB and union contractor names were first edited to standardize them. Non-substantive words and punctuation were removed or edited, and the resulting words were then concatenated to produce a text string (e.g. ROBSPLUMBING in the above cases). The similarity of two text strings were then compared using the SPEDIS or COMPGED functions in SAS. These functions compared text strings and computed the asymmetric spelling distance and

generalized edit distance, respectively. A score of zero was assigned if the text strings were perfectly matched, and a positive integer was assigned if they were not, with higher values indicating greater dissimilarity. Based on preliminary work, name pairs were automatically considered matched if their SPEDIS score was <23 (false positive rate = 0%); pairs were manually screened if their scores were between 23 and 60; and pairs were automatically excluded if their scores were >60. Pairings between union contractor names and each of WSIB legal and trade names were considered in Steps 2 and 3; for Step 4, the pairing between union contractor name and WSIB legal name was considered. Preliminary work had established that, among matched pairs, 82% could be matched using the WSIB legal name variable, whereas 18% required the WSIB trade name.

For the fifth linkage step, the cosine similarity between name pairs was determined using the R® software package text2vec (Selivanov, 2016). In contrast to linkage Steps 2 to 4, names were not edited first. The cosine similarity distance took values from 0 to 1, with identical names resulting in a cosine similarity equal to 1. The computer selected, for each WSIB employer record, the best-matching record from the union contractor list, based on comparisons of all union contractor names to the legal name found in each WSIB employer record. Candidate record pairs with name similarity values above 0.7 were manually screened, and a match was selected if the likelihood was high that they represented the same organization. This decision considered all available information in the putatively matched records, as well as the uniqueness of the name under consideration in WSIB records (WSIB, 2020).

The Amick et al. (2015) study did not include Steps 4 and 5. Instead, for records with only a name variable available, in the early stages of the project, a search of the Internet was conducted on the name and, if an appropriate match was found, the PC and PN were extracted from the website to allow linkage in the first three steps.

Of the 107,939 WSIB records in the initial sample, 5,451 were classified as unionized based on strong matches (Steps 1-3) and 6,568 were classified as unionized based on both strong and weak matches (Steps 1-5). For the analytical sample of 60,425, the corresponding values were 5,267 and 6,224, respectively.

Check of record linkage

After the five linkage steps were performed and the remaining union contractor records were deduplicated on edited company name,15,813 of them remained unmatched. As these posed a threat to the validity of the study due to the potential misclassification of many WSIB employers as non-unionized when they were really unionized, a manual investigation of a sample of 200 of the unmatched union contractor records was carried out to determine whether they could be found in the initial WSIB sample of 107,939 companies and how this affected the analytical sample of company-CUs. An Excel version of the WSIB data was searched on company name and on street address, using a limited selection of search terms at a time, and considering possible misspellings. Of the 200 union contractor records, 16 (8%) were matched to 16 different WSIB employer accounts. However, nine of these had been previously matched to a (replicate) union contractor record, leaving seven companies which were not matched to WSIB records through the five linkage steps. Of the seven companies which failed to be matched, five, each with a since company-CU, were found in the analytical sample, once the study sample exclusions were applied. Scaling this finding up to the entire set of 15,813 unmatched records, yields an estimate of 395 company-CUs in the analytical sample of 60,425 company-CUs being misclassified as non-unionized when they were actually unionized.

Further investigation was undertaken with a sample of 50 unmatched union contractor records. Four (8%) had been matched to 2012-18 WSIB records as described above. For the remaining records, the following methods were used: 1) search of the WSIB Safetycheck database containing records of all employers (all sectors) registered with the WSIB in 2019 (WSIB, 2020), which allowed for a determination of whether a company was part of the ICI sector; 2) search of a registry of active and non-active businesses in Ontario, Quebec, B.C., Alberta and Saskatchewan (Canadian Association of Corporate Law Administrators, 2020); and 3) search of the Internet on name (first four webpages). The remaining results, relative to the sample of 50, were as follows: 40% inactive businesses, 14% non-ICI active businesses (determined on WSIB Safetycheck), 12% other active businesses (likely small, since no websites, and uncertain whether part of ICI sector), and 26% unknown (most had a construction name, but uncertain whether part of ICI sector).

Statistical analysis

All statistical analyses were performed with SAS v9.4.

Outcomes

Several outcome variables were created from WSIB data as counts of claims within a company-CU, cumulative 2012-2018: 1) lost-time allowed claims; 2) LTA claims for musculoskeletal disorders; 3) LTA claims for critical injuries, defined as injuries that jeopardize life, cause blindness, or result in amputation, major burns, fractures of large bones or loss of consciousness; 4) no-lost-time allowed claims; 5) total allowed (both lost-time and no-lost-time); 6) total allowed and not allowed claims. The critical injury category is based on an algorithm using nature of the injury, part of body and nature of the event; it is intended to correspond to more severe workplace injuries, which require investigation by Ontario's labour authorities.

Main independent variable

Unionization was a dichotomous variable: any WSIB record that had been matched to a union contractor record was classified as unionized; any unmatched record was classified as non-unionized. For the main analysis, only strong matches were used to define unionized. For a sensitivity analysis, weak matches were also used.

Other independent variables

Company size. Company size was included as a variable because of the well-established inverse relationship between injury rate and firm size, related to the greater amount and quality of resources devoted to occupational health and safety in larger companies. Company size was a five-level categorical variable based on average FTEs for the years included in the sample for the company: 0-1, 2-4, 5-19, 20-49, 50+. Cutoffs for these categories were based on several considerations of the regulatory environment: self-employed individuals are required to register with WSIB; supervisors are not required onsite when fewer than five workers are present; 20-plus workers necessitates a joint health and safety committee; and 50-plus workers requires a work trades committee.

Classification unit (industrial sub-sector). To control for different types of hazards associated with different types of work, a 39-level categorical variable corresponding to type of ICI sub-sector (e.g. Carpeting & Flooring) was included. This study added one CU category not included in the Amick et al. (2015) study: Apartment &

Condominium Construction. Although it is a type of residential construction, it is considered to be part of the ICI industry in Ontario.

Organizational complexity. A five-level categorical variable corresponding to the number of CUs in the organization was included: 1, 2, 3, 4, 5+. The presumption was that more complex organizations may be more sophisticated and have the resources to better manage OHS.

Geographical region. This was a six-level variable created from the first letter of the postal code: K, L, M, N, P, other (other province or country). It was intended to control for regional variation in OHS culture, knowledge and enforcement.

While time since WSIB registration was found to differ between union and non-union companies, it was not included as a covariate. Amick et al. (2015) had found it was correlated with company size and prevented model convergence. Furthermore, they found its inclusion did not substantially affect estimates of union effect.

Negative binomial regression

Negative binomial (NB) regression modeling was undertaken separately for each of the six claims-based outcomes. Outcomes were claim counts, and natural log FTEs was used as an offset variable. All models used unionization as the main independent variable. Adjusted models included company size, classification unit, organizational complexity and geographical region variables as covariates. Preliminary work showed that company size had the greatest impact on the union estimate. All crude and adjusted models showed a dispersion coefficient (alpha) greater than zero, consistent with a negative binomial model.

Models were separately developed for LTA claims for different sub-groups based on company size (FTEs). Models failed to converge for some sub-groups, and this was associated with too few claim counts in some CU categories. The solution was to exclude the company-CUs belonging to the problematic CU categories from analysis for all of the size categories. Thus, company-CUs from three CU categories were excluded, reducing the sample size of company-CUs from 60,425 to 60,337.

Models were also separately developed for selected CU categories with LTA injury claims as the outcome – to examine variation in the union effects across CUs and to provide trade-specific estimates for report users. An *a priori* criterion of 0.5 for the

width of the confidence interval of the adjusted risk ratio was developed as the basis for selecting CU categories. Seven categories met this criterion.

Alternative approaches to modeling claim counts, appropriate for a distribution with overdispersion and excess zero counts, including zero-inflated negative binomial (ZINB) and zero-inflated Poisson (ZIP), were explored using LTA claims. Comparative fit indices of AIC, AICC and BIC, and the tests of Vuong (1989) and Clarke (Clarke and Signorino, 2010), indicated the NB and ZINB models were preferred to the ZIP model. The NB model was ultimately chosen because it converged more reliably than ZINB and did not require a theory to explain excess zero counts. Although the Vuong and Clarke tests favoured ZINB modeling, comparative fit indices showed little advantage of ZINB over NB. The choice between these models did not affect the regression coefficient for the unionization variable. In addition, we explored regression models for LTA claims that account for the potential correlation among the observations from company-CUs belonging to the same company. CUs belonging to the same company were specified by the company account number in the “repeated” statement with an exchangeable correlation matrix for error terms. This had little impact on the estimates and was, therefore, not routinely used. Finally, given the importance of the firm size variable in estimations of the union effect, variations on its specification were explored – as a continuous variable FTEs or log FTEs – but they offered no benefit, nor did models including interaction terms of a continuous FTE variable with each of the other independent variables.

Appendix B: Sources of union contractor lists

Union sources

Brick and Allied Craft Union of Canada

Carpenters' District Council of Ontario

International Association of Heat and Frost Insulators

International Brotherhood of Electrical Workers

International Union of Operating Engineers

International Union of Painters and Allied Trades

Iron Workers District Council of Ontario

Laborers' International Union of North America (LIUNA) Ontario Provincial District Council

Ontario Pipe Trades Council

Operative Plasterers' and Cement Masons' International Association

United Association Local 853 (Sprinkler Fitters of Ontario)

Employer association sources

Association of Millwrighting Contractors of Ontario

Boilermaker Contractors' Association

Cement Finishing Labour Relations Association

Electrical Contractors Association of Ontario

Mechanical Contractors Association of Ontario

Ontario Association of Demolition Contractors

Ontario Erectors Association

Ontario Industrial Roofing Contractors Association

Ontario Masonry Contractors' Association

Ontario Painting Contractors Association

Ontario Refrigeration & Air Conditioning Contractors Association

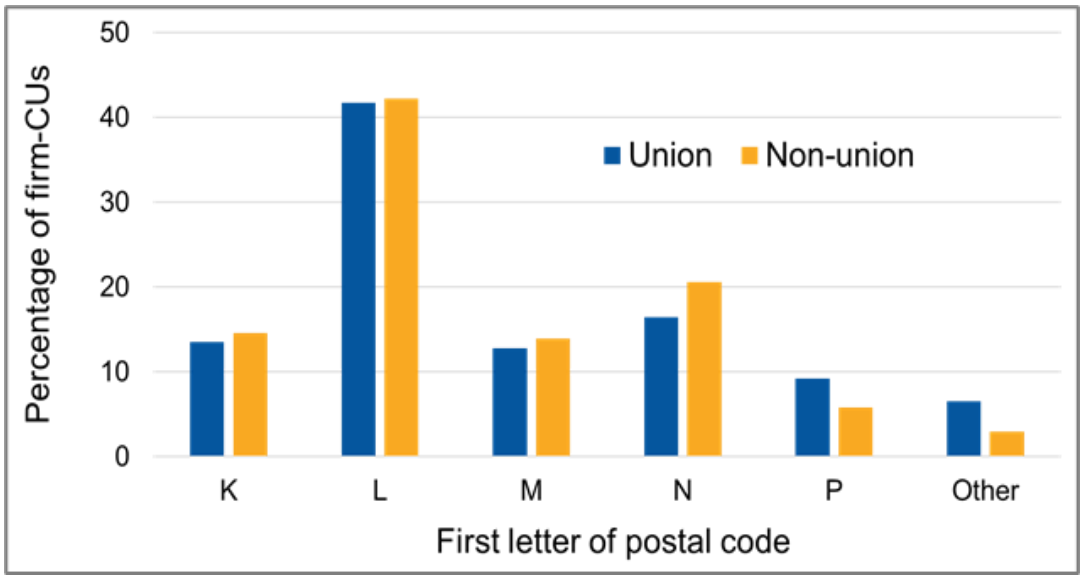
Ontario Sheet Metal Contractors Association

Terrazzo, Tile and Marble Association of Canada

Appendix C: Distribution of unionized and non-unionized company-CUs in the study sample by year of registration with WSIB

Year of WSIB Registration	Union		Non-union	
	Number	%	Number	%
Pre-1980	184	3.5	530	1.0
1980-1989	699	13.3	3115	5.7
1990-1994	422	8.0	2090	3.8
1995-1999	561	10.7	3181	5.8
2000-2004	1216	23.1	7213	13.1
2005	152	2.9	1681	3.1
2006	141	2.7	1743	3.2
2007	148	2.8	1752	3.2
2008	148	2.8	2083	3.8
2009	154	2.9	1913	3.5
2010	190	3.6	2240	4.1
2011	172	3.3	2423	4.4
2012	174	3.3	2677	4.9
2013	260	4.9	9897	17.9
2014	184	3.5	4084	7.4
2015	143	2.7	3119	5.7
2016	151	2.9	2688	4.9
2017	114	2.2	2001	3.6
2018	54	1.0	728	1.3
Subtotals				
Pre-2005	3,082	58.5	16,129	29.2
2005-2012	1,279	24.3	16,512	29.9
2013+	906	17.2	22,517	40.8
All years	5,267	100.0	55,158	100.0

Appendix D: Distribution of unionized and non-unionized company-CUs in the study sample by first letter of postal code



Distribution of unionized (n = 5,267) and non-unionized (n = 55,158) company-CUs in the study sample by first letter of postal code.

Appendix E: Distribution of unionized and non-unionized company-CUs in the study sample by WSIB classification unit type

WSIB Classification Unit Code	WSIB Classification Unit Title	Unionized		Non-Unionized	
		Number	%	Number	%
4261000	Electrical Work	900	17.1	8058	14.6
4241099	Plumbing, Heating & Air Conditioning, Installation	783	14.9	8831	16.0
4021099	Industrial, Commercial and Institutional Construction	513	9.7	2903	5.3
4271099	Plaster, Drywall and Acoustical Work	475	9.0	4081	7.4
4214000	Excavating and Grading	290	5.5	2386	4.3
4232000	Siding Work	207	3.9	3682	6.7
4275001	Painting and Decorating	205	3.9	5809	10.5
4255000	Millwright and Rigging Work	160	3.0	579	1.1
4215000	Equipment Rental (with Operator)	149	2.8	307	0.6
4231000	Masonry Operations	141	2.7	2462	4.5
4233000	Glass and Glazing Work	127	2.4	453	0.8
4292000	Ornamental and Fabricated Metal Installation	101	1.9	464	0.8
4224001	Concrete Finishing	85	1.6	1009	1.8
4222001	Form Work (High-Rise)	81	1.5	55	0.1
4256000	Thermal Insulation Work	81	1.5	82	0.2
4236000	Sheet Metal and Built-Up Roofing	80	1.5	559	1.0
4244000	Sheet Metal and Other Duct Work	79	1.5	573	1.0
4227000	Structural Steel Erection	76	1.4	81	0.2
4277099	Carpeting and Flooring	74	1.4	3649	6.6
4234001	Insulation Work	60	1.1	474	0.9
4276000	Terrazzo and Tile Work	54	1.0	2785	5.1
4299000	Other Trade Work	52	1.0	107	0.2

WSIB Classification Unit Code	WSIB Classification Unit Title	Unionized		Non-Unionized	
		Number	%	Number	%
4259000	Industrial Maintenance and Repair Contracting	50	1.0	682	1.2
4234003	Asbestos Abatement	44	0.8	85	0.2
4224003	Concrete Sealing	40	0.8	375	0.7
4223000	Steel Reinforcing	39	0.7	55	0.1
4235000	Roof Shingling	39	0.7	2757	5.0
9942000	Custom Welding Services	37	0.7	595	1.1
4211002	Non-Structural Interior Demolition	35	0.7	167	0.3
4221000	Piledriving Work	33	0.6	70	0.1
4012000	Apartment and Condominium Construction	32	0.6	282	0.5
4211001	Wrecking and Structural Demolition	26	0.5	56	0.1
4224002	Concrete Cutting and Drilling	25	0.5	148	0.3
4239000	Caulking and Weatherstripping	24	0.5	204	0.4
4241002	Drain Contractors	23	0.4	229	0.4
4111099	Heavy Engineering Construction	21	0.4	34	0.1
4275002	Painting of Structures	17	0.3	14	0.0
4225000	Precast Concrete Installation	8	0.2	15	0.0
4229000	Other Structural Work	1	0.0	1	0.0
		5,267	100.0	55,158	100.0

Table is ordered by number of unionized company-CUs.

Appendix F: Detailed regression modeling results related to Table 2

This appendix presents the detailed regression results for the 12 models summarized in Table 2, first the fully adjusted models, followed by the crude models. Counts of company-CUs, claims and FTEs are reported in Table 1.

Adjusted models

	Lost-time allowed (LTA)			**Musculoskeletal LTA**		
Parameter	**Estimate**	**Wald 95% Confidence Limits**		**Estimate**	**Wald 95% Confidence Limits**	
Intercept	**-4.8444**	**-4.9992**	**-4.6896**	**-5.5983**	**-5.8241**	**-5.3725**
Union (main independent variable)	**-0.2839**	**-0.3477**	**-0.2202**	**-0.2590**	**-0.3520**	**-0.1660**
Classification Unit (ref: Carpeting & Flooring)						
Apartment and Condominium Construction	-0.1374	-0.4127	0.1379	**-0.5163**	**-0.9346**	**-0.0979**
Asbestos Abatement	-0.0512	-0.4698	0.3675	**-0.8064**	**-1.5377**	**-0.0750**
Caulking and Weatherstripping	0.1041	-0.2931	0.5012	-0.3605	-0.9930	0.2720
Concrete Cutting and Drilling	0.1277	-0.2260	0.4814	-0.0398	-0.5564	0.4769
Concrete Finishing	0.1317	-0.0654	0.3287	-0.2063	-0.5100	0.0975
Concrete Sealing	0.2061	-0.0576	0.4698	0.0266	-0.3687	0.4220
Custom Welding Services	**0.3472**	**0.1007**	**0.5938**	**-0.5999**	**-1.0788**	**-0.1209**
Drain Contractors	0.2385	-0.0456	0.5226	0.1121	-0.2864	0.5106
Electrical Work	**-0.2259**	**-0.3599**	**-0.0920**	**-0.5644**	**-0.7682**	**-0.3605**
Equipment Rental (With Operator)	-0.0783	-0.3278	0.1712	**-0.6627**	**-1.0667**	**-0.2587**
Excavating and Grading	-0.1364	-0.2937	0.0209	**-0.6675**	**-0.9158**	**-0.4192**
Form Work (High-Rise)	**1.1207**	**0.8490**	**1.3924**	**0.8243**	**0.4672**	**1.1813**
Glass and Glazing Work	**0.5104**	**0.3050**	**0.7157**	0.2180	-0.0871	0.5231
Heavy Engineering Construction	0.1836	-0.2809	0.6481	-0.3175	-0.9693	0.3343
Industrial Maintenance and Repair Contracting	**-0.3966**	**-0.6315**	**-0.1616**	**-0.7032**	**-1.0595**	**-0.3469**
Industrial, Commercial & Institutional Construction	-0.1177	-0.2611	0.0257	**-0.6461**	**-0.8647**	**-0.4274**
Insulation Work	**0.5526**	**0.3303**	**0.7749**	-0.0134	-0.3673	0.3406
Masonry Operations	**0.5449**	**0.3943**	**0.6954**	0.2127	-0.0182	0.4437
Millwright and Rigging Work	-0.2001	-0.4056	0.0053	**-0.9201**	**-1.2471**	**-0.5930**
Non-Structural Interior Demolition	**0.3847**	**0.0514**	**0.7180**	-0.1760	-0.6999	0.3480
Ornamental & Fabricated Metal Installation	**0.6308**	**0.4002**	**0.8615**	-0.0300	-0.4180	0.3580
Other Structural Work	**2.3834**	**0.4036**	**4.3632**	-15.7817	-14780.4	14748.86
Other Trade Work	0.2377	-0.0979	0.5734	-0.0432	-0.5061	0.4198
Painting and Decorating	**-0.3366**	**-0.4937**	**-0.1794**	**-0.5978**	**-0.8467**	**-0.3490**
Painting Of Structures	0.2946	-0.5865	1.1758	-1.2452	-3.3451	0.8547
Piledriving Work	**0.4715**	**0.0699**	**0.8730**	-0.1249	-0.7312	0.4813
Plaster, Drywall and Acoustical Work	-0.0735	-0.2252	0.0782	**-0.5376**	**-0.7759**	**-0.2993**

	Lost-time allowed (LTA)			Musculoskeletal LTA		
Parameter	**Estimate**	**Wald 95% Confidence Limits**		**Estimate**	**Wald 95% Confidence Limits**	
Plumbing, Heating & Air Conditioning, Installation	**0.1903**	**0.0604**	**0.3202**	-0.0588	-0.2547	0.1371
Precast Concrete Installation	**0.9224**	**0.1432**	**1.7017**	0.2477	-0.8287	1.3240
Roof Shingling	**0.7606**	**0.6110**	**0.9101**	-0.2281	-0.4868	0.0305
Sheet Metal and Built-Up Roofing	**0.2018**	**0.0008**	**0.4028**	**-0.3482**	**-0.6448**	**-0.0517**
Sheet Metal and Other Duct Work	0.0165	-0.2051	0.2381	-0.2643	-0.5978	0.0693
Siding Work	**0.3859**	**0.2389**	**0.5329**	-0.0349	-0.2647	0.1950
Steel Reinforcing	0.2691	-0.1426	0.6808	-0.1297	-0.6769	0.4176
Structural Steel Erection	**1.0847**	**0.7444**	**1.4250**	0.3752	-0.1695	0.9198
Terrazzo and Tile Work	-0.1283	-0.3152	0.0585	-0.0941	-0.3755	0.1873
Thermal Insulation Work	**-0.4811**	**-0.8613**	**-0.1009**	**-1.3279**	**-1.9742**	**-0.6815**
Wrecking and Structural Demolition	**0.8832**	**0.3972**	**1.3691**	0.5536	-0.1600	1.2672
Postal code, first letter (ref: L)						
K	**0.1993**	**0.1363**	**0.2623**	**0.3326**	**0.2342**	**0.4309**
M	0.0023	-0.0691	0.0738	-0.0713	-0.1858	0.0432
N	**0.1590**	**0.1007**	**0.2173**	**0.2601**	**0.1674**	**0.3527**
P	0.0680	-0.0248	0.1609	**0.2401**	**0.0959**	**0.3843**
Other	**0.1702**	**0.0489**	**0.2916**	**0.2928**	**0.1117**	**0.4739**
Complexity, number of CUs in company (ref: 1)						
2	**0.0872**	**0.0293**	**0.1452**	0.0477	-0.0396	0.1350
3	**0.2747**	**0.1779**	**0.3715**	0.1309	-0.0125	0.2742
4	**0.2724**	**0.1263**	**0.4185**	0.1775	-0.0338	0.3887
5 or More	**0.2485**	**0.0966**	**0.4004**	0.1186	-0.0973	0.3345
Firm size (ref: 50+ FTE)						
0-1 FTE	**0.5282**	**0.4237**	**0.6327**	**0.1588**	**0.0007**	**0.3169**
2-4 FTE	**0.3892**	**0.2897**	**0.4887**	**0.1498**	**0.0061**	**0.2934**
5-19 FTE	**0.5081**	**0.4184**	**0.5978**	**0.3847**	**0.2637**	**0.5056**
20-49 FTE	**0.2715**	**0.1742**	**0.3688**	**0.2645**	**0.1373**	**0.3916**
Dispersion	1.1458	1.0823	1.2129	1.3061	1.1746	1.4524
Goodness of Fit Statistics						
Akaike information criterion (AIC)	58638			26137		
Bayesian Information Criterion (BIC)	59125			26624		

	Critical (severe) LTA			No-lost-time allowed		
Parameter	**Estimate**	**Wald 95% Confidence Limits**		**Estimate**	**Wald 95% Confidence Limits**	
Intercept	**-7.9839**	**-8.5149**	**-7.4529**	**-4.2323**	**-4.4049**	**-4.0596**
Union (main independent variable)	**-0.1798**	**-0.3207**	**-0.0390**	0.0351	-0.0158	0.0859
Classification Unit (ref: Carpeting & Flooring)						
Apartment and Condominium Construction	0.4590	-0.3391	1.2570	**0.3950**	**0.1237**	**0.6663**
Asbestos Abatement	0.6189	-0.5057	1.7434	**1.0653**	**0.7292**	**1.4013**
Caulking and Weatherstripping	0.4167	-0.8413	1.6747	**0.4599**	**0.0478**	**0.8721**
Concrete Cutting and Drilling	0.4577	-0.6642	1.5796	**1.0851**	**0.7684**	**1.4018**
Concrete Finishing	**0.7214**	**0.0637**	**1.3790**	**0.6790**	**0.4698**	**0.8881**
Concrete Sealing	0.5522	-0.3147	1.4192	**0.9336**	**0.6756**	**1.1916**
Custom Welding Services	**1.2780**	**0.5336**	**2.0223**	**1.4792**	**1.2462**	**1.7123**
Drain Contractors	0.7293	-0.0899	1.5485	**1.0532**	**0.7841**	**1.3223**
Electrical Work	**0.6657**	**0.1500**	**1.1814**	**0.8979**	**0.7383**	**1.0574**
Equipment Rental (With Operator)	**0.7966**	**0.0975**	**1.4957**	**0.6563**	**0.4208**	**0.8918**
Excavating and Grading	**1.0922**	**0.5519**	**1.6324**	**0.5982**	**0.4230**	**0.7735**
Form Work (High-Rise)	**2.0421**	**1.4422**	**2.6420**	**2.2203**	**1.9658**	**2.4748**
Glass and Glazing Work	**1.1978**	**0.5531**	**1.8425**	**1.3567**	**1.1450**	**1.5684**
Heavy Engineering Construction	**1.1298**	**0.1834**	**2.0762**	**1.4355**	**1.0231**	**1.8480**
Industrial Maintenance and Repair Contracting	0.1443	-0.5951	0.8837	**0.6925**	**0.4679**	**0.9171**
Industrial, Commercial & Institutional Construction	**0.6960**	**0.1687**	**1.2234**	**0.9875**	**0.8239**	**1.1511**
Insulation Work	**1.7328**	**1.1122**	**2.3533**	**1.0139**	**0.7796**	**1.2481**
Masonry Operations	**1.0079**	**0.4519**	**1.5639**	**0.6785**	**0.4963**	**0.8607**
Millwright and Rigging Work	**0.7245**	**0.1094**	**1.3396**	**1.1752**	**0.9796**	**1.3708**
Non-Structural Interior Demolition	**0.9787**	**0.0502**	**1.9072**	**1.2754**	**0.9683**	**1.5825**
Ornamental & Fabricated Metal Installation	**0.8307**	**0.0271**	**1.6344**	**1.4101**	**1.1778**	**1.6425**
Other Structural Work	-14.3801	-22799	22770	**2.2254**	**0.1218**	**4.3291**
Other Trade Work	0.7233	-0.1226	1.5691	**0.7653**	**0.4408**	**1.0898**
Painting and Decorating	**0.6171**	**0.0531**	**1.1811**	-0.1695	-0.3654	0.0265
Painting Of Structures	1.3118	-0.7732	3.3968	**1.2291**	**0.5834**	**1.8748**
Piledriving Work	**1.6972**	**0.8985**	**2.4959**	**1.5416**	**1.2035**	**1.8797**
Plaster, Drywall and Acoustical Work	**0.8739**	**0.3356**	**1.4123**	**0.2404**	**0.0604**	**0.4204**
Plumbing, Heating & Air Conditioning, Installation	**0.6980**	**0.1847**	**1.2113**	**1.2307**	**1.0729**	**1.3885**
Precast Concrete Installation	**1.7865**	**0.4174**	**3.1556**	**2.1491**	**1.4502**	**2.8481**
Roof Shingling	**1.7057**	**1.1686**	**2.2427**	**0.8554**	**0.6731**	**1.0377**
Sheet Metal and Built-Up Roofing	**0.8201**	**0.2139**	**1.4263**	**1.0233**	**0.8201**	**1.2266**
Sheet Metal and Other Duct Work	0.6371	-0.0531	1.3272	**1.7161**	**1.5143**	**1.9180**
Siding Work	**0.8947**	**0.3377**	**1.4517**	**1.0045**	**0.8314**	**1.1777**
Steel Reinforcing	0.7076	-0.1925	1.6077	**1.4016**	**1.0620**	**1.7412**

	Critical (severe) LTA			No-lost-time allowed		
Parameter	**Estimate**	**Wald 95% Confidence Limits**		**Estimate**	**Wald 95% Confidence Limits**	
Structural Steel Erection	**1.8414**	**1.0094**	**2.6735**	**1.6777**	**1.3736**	**1.9819**
Terrazzo and Tile Work	0.1509	-0.5727	0.8746	0.0982	-0.1355	0.3319
Thermal Insulation Work	**0.8620**	**0.0161**	**1.7078**	**0.5500**	**0.2432**	**0.8569**
Wrecking and Structural Demolition	**1.8675**	**0.8467**	**2.8883**	**1.7869**	**1.3851**	**2.1888**
Postal code, first letter (ref: L)						
K	0.0944	-0.0650	0.2537	**0.3583**	**0.3013**	**0.4153**
M	-0.0308	-0.2015	0.1399	**-0.3356**	**-0.4052**	**-0.2660**
N	-0.0935	-0.2441	0.0572	**0.5538**	**0.5030**	**0.6046**
P	0.0944	-0.1347	0.3234	**0.5941**	**0.5190**	**0.6692**
Other	-0.1448	-0.4326	0.1429	**-0.2499**	**-0.3651**	**-0.1346**
Complexity, number of CUs in company (ref: 1)						
2	-0.0513	-0.1874	0.0848	**0.2115**	**0.1628**	**0.2603**
3	-0.0740	-0.2935	0.1454	**0.4302**	**0.3525**	**0.5079**
4	-0.0886	-0.3942	0.2171	**0.4108**	**0.3005**	**0.5211**
5 or More	0.0043	-0.3028	0.3114	**0.5310**	**0.4185**	**0.6434**
Firm size (ref: 50+ FTE)						
0-1 FTE	**0.6374**	**0.4015**	**0.8732**	**-1.4806**	**-1.5787**	**-1.3825**
2-4 FTE	**0.3729**	**0.1546**	**0.5912**	**-1.0755**	**-1.1591**	**-0.9919**
5-19 FTE	**0.5191**	**0.3457**	**0.6925**	**-0.2169**	**-0.2945**	**-0.1393**
20-49 FTE	**0.2209**	**0.0390**	**0.4028**	**-0.5086**	**-0.5812**	**-0.4360**
Dispersion	0.5693	0.3736	0.8676	0.9471	0.9057	0.9904
Goodness of Fit Statistics						
Akaike information criterion (AIC)	11099			69189		
Bayesian Information Criterion (BIC)	11585			69675		

	Total allowed			Total allowed and not allowed		
Parameter	**Estimate**	**Wald 95% Confidence Limits**		**Estimate**	**Wald 95% Confidence Limits**	
Intercept	**-3.5089**	**-3.6336**	**-3.3841**	**-3.2951**	**-3.4121**	**-3.1781**
Union (main independent variable)	**-0.0519**	**-0.0969**	**-0.0068**	-0.0170	-0.0610	0.0269
Classification Unit (ref: Carpeting & Flooring)						
Apartment and Condominium Construction	0.0162	-0.1988	0.2311	-0.0404	-0.2451	0.1644
Asbestos Abatement	**0.5242**	**0.2406**	**0.8079**	**0.4456**	**0.1741**	**0.7170**
Caulking and Weatherstripping	0.2315	-0.0874	0.5505	0.1419	-0.1610	0.4448
Concrete Cutting and Drilling	**0.5388**	**0.2792**	**0.7984**	**0.4127**	**0.1609**	**0.6645**
Concrete Finishing	**0.3048**	**0.1496**	**0.4599**	**0.2681**	**0.1235**	**0.4128**
Concrete Sealing	**0.4900**	**0.2894**	**0.6907**	**0.4642**	**0.2748**	**0.6535**
Custom Welding Services	**0.8761**	**0.6979**	**1.0544**	**0.7371**	**0.5682**	**0.9061**
Drain Contractors	**0.5434**	**0.3256**	**0.7612**	**0.4412**	**0.2318**	**0.6506**
Electrical Work	**0.3128**	**0.2040**	**0.4216**	**0.2245**	**0.1248**	**0.3241**
Equipment Rental (With Operator)	**0.2053**	**0.0207**	**0.3900**	0.1368	-0.0387	0.3122
Excavating and Grading	**0.1597**	**0.0350**	**0.2843**	0.1037	-0.0117	0.2191
Form Work (High-Rise)	**1.6545**	**1.4427**	**1.8663**	**1.5362**	**1.3283**	**1.7441**
Glass and Glazing Work	**0.8322**	**0.6710**	**0.9934**	**0.7088**	**0.5558**	**0.8618**
Heavy Engineering Construction	**0.8027**	**0.4477**	**1.1578**	**0.7125**	**0.3627**	**1.0623**
Industrial Maintenance and Repair Contracting	0.1220	-0.0511	0.2952	0.0444	-0.1191	0.2079
Industrial, Commercial & Institutional Construction	**0.4466**	**0.3324**	**0.5608**	**0.3610**	**0.2555**	**0.4664**
Insulation Work	**0.6752**	**0.4975**	**0.8528**	**0.5976**	**0.4287**	**0.7666**
Masonry Operations	**0.5585**	**0.4327**	**0.6843**	**0.5210**	**0.4051**	**0.6369**
Millwright and Rigging Work	**0.5649**	**0.4158**	**0.7141**	**0.4672**	**0.3259**	**0.6085**
Non-Structural Interior Demolition	**0.7879**	**0.5382**	**1.0376**	**0.6661**	**0.4240**	**0.9083**
Ornamental & Fabricated Metal Installation	**0.9620**	**0.7853**	**1.1386**	**0.8120**	**0.6437**	**0.9802**
Other Structural Work	**2.1203**	**0.4192**	**3.8213**	**1.8400**	**0.1324**	**3.5476**
Other Trade Work	**0.3597**	**0.0914**	**0.6281**	**0.2703**	**0.0099**	**0.5307**
Painting and Decorating	**-0.2742**	**-0.4053**	**-0.1432**	**-0.2672**	**-0.3860**	**-0.1483**
Painting Of Structures	**0.7246**	**0.1603**	**1.2888**	**0.8340**	**0.3072**	**1.3607**
Piledriving Work	**0.9910**	**0.7046**	**1.2774**	**0.8667**	**0.5874**	**1.1460**
Plaster, Drywall and Acoustical Work	0.0011	-0.1244	0.1265	-0.0743	-0.1900	0.0414
Plumbing, Heating & Air Conditioning, Installation	**0.6685**	**0.5616**	**0.7754**	**0.5738**	**0.4760**	**0.6715**
Precast Concrete Installation	**1.5720**	**0.9698**	**2.1742**	**1.4154**	**0.8302**	**2.0006**
Roof Shingling	**0.7767**	**0.6517**	**0.9016**	**0.6764**	**0.5610**	**0.7919**
Sheet Metal and Built-Up Roofing	**0.5697**	**0.4133**	**0.7261**	**0.5044**	**0.3560**	**0.6527**
Sheet Metal and Other Duct Work	**1.0032**	**0.8489**	**1.1575**	**0.8808**	**0.7343**	**1.0273**
Siding Work	**0.6247**	**0.5047**	**0.7447**	**0.5079**	**0.3972**	**0.6186**

	Total allowed			Total allowed and not allowed		
Parameter	**Estimate**	**Wald 95% Confidence Limits**		**Estimate**	**Wald 95% Confidence Limits**	
Steel Reinforcing	**0.8633**	**0.5687**	**1.1578**	**0.7834**	**0.4960**	**1.0707**
Structural Steel Erection	**1.3176**	**1.0667**	**1.5685**	**1.1865**	**0.9424**	**1.4306**
Terrazzo and Tile Work	-0.0521	-0.2091	0.1048	-0.0650	-0.2075	0.0774
Thermal Insulation Work	0.0457	-0.2131	0.3044	0.0096	-0.2401	0.2593
Wrecking and Structural Demolition	**1.2851**	**0.9466**	**1.6237**	**1.1438**	**0.8148**	**1.4728**
Postal code, first letter (ref: L)						
K	**0.2950**	**0.2482**	**0.3418**	**0.2803**	**0.2355**	**0.3252**
M	**-0.1789**	**-0.2351**	**-0.1228**	**-0.1640**	**-0.2176**	**-0.1104**
N	**0.4135**	**0.3715**	**0.4556**	**0.3780**	**0.3377**	**0.4184**
P	**0.4084**	**0.3449**	**0.4719**	**0.4092**	**0.3483**	**0.4702**
Other	-0.0783	-0.1738	0.0172	-0.0167	-0.1078	0.0744
Complexity, number of CUs in company (ref: 1)						
2	**0.1780**	**0.1360**	**0.2201**	**0.1844**	**0.1435**	**0.2253**
3	**0.4196**	**0.3509**	**0.4883**	**0.4310**	**0.3636**	**0.4984**
4	**0.4114**	**0.3114**	**0.5114**	**0.4339**	**0.3348**	**0.5329**
5 or More	**0.5421**	**0.4396**	**0.6446**	**0.5635**	**0.4621**	**0.6649**
Firm size (ref: 50+ FTE)						
0-1 FTE	**-0.7226**	**-0.8018**	**-0.6434**	**-0.6035**	**-0.6805**	**-0.5264**
2-4 FTE	**-0.6434**	**-0.7172**	**-0.5697**	**-0.5905**	**-0.6633**	**-0.5177**
5-19 FTE	**-0.2676**	**-0.3343**	**-0.2010**	**-0.2518**	**-0.3184**	**-0.1852**
20-49 FTE	**-0.1308**	**-0.2030**	**-0.0586**	**-0.1269**	**-0.1993**	**-0.0545**
Dispersion	0.8385	0.8057	0.8726	0.8584	0.8268	0.8913
Goodness of Fit Statistics						
Akaike information criterion (AIC)	94341			103728		
Bayesian Information Criterion (BIC)	94828			104215		

Crude models

	Lost-time allowed (LTA)			Musculoskeletal LTA		
Parameter	**Estimate**	**Wald 95% Confidence Limits**		**Estimate**	**Wald 95% Confidence Limits**	
Intercept	**-4.1861**	**-4.2106**	**-4.1617**	**-5.4830**	**-5.5222**	**-5.4438**
Union (main independent variable)	**-0.3653**	**-0.4242**	**-0.3065**	**-0.2861**	**-0.3696**	**-0.2026**
Dispersion	1.3458	1.2761	1.4194	1.5765	1.4308	1.7372
Goodness of Fit Statistics						
Akaike information criterion (AIC)	59642			26522		
Bayesian Information Criterion (BIC)	59669			26549		

	Critical (severe) LTA			No-lost-time allowed		
Parameter	**Estimate**	**Wald 95% Confidence Limits**		**Estimate**	**Wald 95% Confidence Limits**	
Intercept	**-6.7788**	**-6.8448**	**-6.7127**	**-3.7956**	**-3.8172**	**-3.7740**
Union (main independent variable)	**-0.3424**	**-0.4656**	**-0.2192**	**0.5878**	**0.5383**	**0.6372**
Dispersion	1.0978	0.8374	1.4391	1.6984	1.6337	1.7657
Goodness of Fit Statistics						
Akaike information criterion (AIC)	11243			75180		
Bayesian Information Criterion (BIC)	11270			75207		

	Total allowed			Total allowed and not allowed		
Parameter	**Estimate**	**Wald 95% Confidence Limits**		**Estimate**	**Wald 95% Confidence Limits**	
Intercept	**-3.2859**	**-3.3035**	**-3.2682**	**-3.1246**	**-3.1415**	**-3.1077**
Union (main independent variable)	**0.3353**	**0.2928**	**0.3777**	**0.3416**	**0.3002**	**0.3829**
Dispersion	1.2337	1.1908	1.2782	1.2088	1.1687	1.2503
Goodness of Fit Statistics						
Akaike information criterion (AIC)	98585			107676		
Bayesian Information Criterion (BIC)	98612			107703		

Appendix G: Detailed regression modeling results related to Table 3

This appendix presents the detailed regression results with LTA injury claims for the 8 models summarized in Table 3, first the fully adjusted models, followed by the crude models.

Adjusted models

	0-4 FTE			5-19 FTE		
Parameter	**Estimate**	**Wald 95% Confidence Limits**		**Estimate**	**Wald 95% Confidence Limits**	
Intercept	**-4.2923**	**-4.4354**	**-4.1492**	**-4.7706**	**-5.0594**	**-4.4818**
Union (main independent variable)	-0.0152	-0.1711	0.1407	**-0.2813**	**-0.3771**	**-0.1855**
Classification Unit (ref: Carpeting & Flooring)						
Apartment and Condominium Construction	-0.1522	-0.7953	0.4909	0.1008	-0.3678	0.5694
Asbestos Abatement	0.0616	-0.7913	0.9146	0.5736	-0.0220	1.1692
Caulking and Weatherstripping	0.1781	-0.3536	0.7098	0.2740	-0.5022	1.0501
Concrete Cutting and Drilling	-0.2913	-1.0240	0.4415	**0.6491**	**0.1087**	**1.1894**
Concrete Finishing	-0.0344	-0.3054	0.2367	**0.6389**	**0.2476**	**1.0303**
Concrete Sealing	-0.1915	-0.6293	0.2462	**0.9191**	**0.4676**	**1.3706**
Custom Welding Services	0.0660	-0.2734	0.4054	**0.9055**	**0.4393**	**1.3718**
Drain Contractors	-0.0748	-0.6240	0.4745	**0.6008**	**0.1080**	**1.0936**
Electrical Work	**-0.4578**	**-0.6266**	**-0.2890**	0.1752	-0.1216	0.4720
Equipment Rental (With Operator)	-0.4175	-0.8939	0.0589	0.3525	-0.0725	0.7775
Excavating and Grading	**-0.3464**	**-0.5699**	**-0.1229**	**0.3551**	**0.0351**	**0.6752**
Form Work (High-Rise)	-0.7330	-2.7906	1.3246	**1.9325**	**1.3666**	**2.4984**
Glass and Glazing Work	-0.1071	-0.4805	0.2663	**0.9994**	**0.6253**	**1.3735**
Industrial Maintenance and Repair Contracting	**-0.8405**	**-1.3071**	**-0.3738**	0.1269	-0.2956	0.5495
Industrial, Commercial & Institutional Construction	-0.1429	-0.3490	0.0633	0.2890	-0.0130	0.5910
Insulation Work	0.1570	-0.1932	0.5072	1.0858	0.6782	1.4935
Masonry Operations	**0.5396**	**0.3550**	**0.7241**	0.7688	0.4452	1.0924
Millwright and Rigging Work	**-0.5386**	**-1.0130**	**-0.0641**	0.0266	-0.3755	0.4287
Non-Structural Interior Demolition	0.3977	-0.1613	0.9567	0.5955	0.0366	1.1544
Ornamental & Fabricated Metal Installation	0.4246	0.0855	0.7637	1.0947	0.6695	1.5199
Other Trade Work	-0.1020	-0.9348	0.7308	0.4722	-0.2161	1.1605
Painting and Decorating	-0.3903	-0.5743	-0.2064	-0.0572	-0.4037	0.2893
Piledriving Work	0.1508	-0.6759	0.9774	**1.1691**	**0.5270**	**1.8112**
Plaster, Drywall and Acoustical Work	-0.1383	-0.3269	0.0502	0.2035	-0.1294	0.5364
Plumbing, Heating & Air Conditioning, Installation	-0.0751	-0.2337	0.0836	**0.7526**	**0.4609**	**1.0443**
Precast Concrete Installation	1.0680	-0.5318	2.6678	0.8817	-1.4748	3.2382
Roof Shingling	**0.7200**	**0.5437**	**0.8963**	**1.0064**	**0.6781**	**1.3348**
Sheet Metal and Built-Up Roofing	0.2391	-0.1133	0.5915	**0.6263**	**0.2364**	**1.0162**
Sheet Metal and Other Duct Work	0.0078	-0.3319	0.3476	**0.4968**	**0.1048**	**0.8888**

	0-4 FTE			5-19 FTE		
Parameter	**Estimate**	**Wald 95% Confidence Limits**		**Estimate**	**Wald 95% Confidence Limits**	
Siding Work	**0.2642**	**0.0852**	**0.4432**	**0.8171**	**0.4974**	**1.1368**
Steel Reinforcing	0.5381	-0.3674	1.4435	0.7161	-0.1592	1.5915
Structural Steel Erection	**1.0414**	**0.3703**	**1.7125**	**1.2665**	**0.7291**	**1.8038**
Terrazzo and Tile Work	**-0.2865**	**-0.5076**	**-0.0655**	0.2605	-0.2025	0.7235
Thermal Insulation Work	-0.4696	-1.3716	0.4324	0.0906	-0.5725	0.7537
Wrecking and Structural Demolition	**0.9309**	**0.0480**	**1.8139**	**1.3936**	**0.5355**	**2.2517**
Postal code, first letter (ref: L)						
K	**0.1739**	**0.0750**	**0.2729**	**0.2503**	**0.1477**	**0.3530**
M	0.0954	-0.0166	0.2073	-0.0392	-0.1629	0.0846
N	**0.2173**	**0.1285**	**0.3061**	**0.1714**	**0.0747**	**0.2682**
P	0.0787	-0.0711	0.2285	**0.1696**	**0.0228**	**0.3164**
Other	**0.2661**	**0.0505**	**0.4816**	0.1641	-0.0481	0.3764
Complexity, number of CUs in company (ref: 1)						
2	**0.1983**	**0.0822**	**0.3145**	0.0609	-0.0222	0.1439
3	**0.3438**	**0.0696**	**0.6180**	**0.3223**	**0.1784**	**0.4662**
4	0.1009	-0.7252	0.9270	0.1120	-0.1272	0.3511
5 or More	0.2828	-0.6875	1.2530	**0.3554**	**0.0574**	**0.6535**
Dispersion	1.6783	1.4776	1.9064	1.0278	0.9357	1.1290
Goodness of Fit Statistics						
Akaike information criterion (AIC)	27433			18373		
Bayesian Information Criterion (BIC)	27846			18705		

Number of company-CUs (union, non-union): 0-4 FTE (1,921, 46,265), 5-19 FTE (1,628, 7,112). Number of LTA claims (union, non-union): 0-4 FTE (234, 4,142); 5-19 FTE (987, 4,846). Number of FTEs (union, non-union): 0-4 FTE (17,522, 280,573); 5-19 FTE (83,174, 303,142)

	20-49 FTE			50+ FTE		
Parameter	**Estimate**	**Wald 95% Confidence Limits**		**Estimate**	**Wald 95% Confidence Limits**	
Intercept	**-4.6603**	**-5.2563**	**-4.0642**	**-4.4314**	**-5.3235**	**-3.5393**
Union (main independent variable)	**-0.2743**	**-0.4019**	**-0.1467**	**-0.5730**	**-0.7295**	**-0.4165**
Classification Unit (ref: Carpeting & Flooring)						
Apartment and Condominium Construction	0.1365	-0.6209	0.8939	-0.1404	-1.2018	0.9210
Asbestos Abatement	-0.9953	-2.3189	0.3284	-0.2680	-1.5692	1.0332
Caulking and Weatherstripping	0.0112	-0.9586	0.9810	-1.2672	-3.7016	1.1672
Concrete Cutting and Drilling	0.5555	-0.3878	1.4987	-0.7483	-2.3849	0.8883
Concrete Finishing	-0.0797	-0.8076	0.6481	0.3007	-0.7272	1.3285
Concrete Sealing	0.2446	-0.5584	1.0476	-0.3731	-1.7056	0.9593
Custom Welding Services	0.5076	-0.3538	1.3691	1.7247	-0.2675	3.7168
Drain Contractors	0.4724	-0.2858	1.2306	0.6726	-0.6324	1.9776
Electrical Work	0.0206	-0.5814	0.6227	0.0196	-0.8818	0.9210
Equipment Rental (With Operator)	0.1913	-0.6103	0.9930	0.1146	-0.9229	1.1520
Excavating and Grading	-0.1979	-0.8288	0.4330	-0.0169	-0.9673	0.9335
Form Work (High-Rise)	**1.0502**	**0.2739**	**1.8264**	**1.1740**	**0.2407**	**2.1073**
Glass and Glazing Work	**0.9040**	**0.1917**	**1.6162**	**1.1026**	**0.0479**	**2.1574**
Industrial Maintenance and Repair Contracting	0.0416	-0.7136	0.7967	-0.4228	-1.4104	0.5648
Industrial, Commercial & Institutional Construction	-0.2508	-0.8518	0.3503	0.0209	-0.8914	0.9333
Insulation Work	0.6431	-0.1211	1.4074	**1.3646**	**0.1986**	**2.5305**
Masonry Operations	0.4447	-0.2019	1.0913	0.7446	-0.2440	1.7333
Millwright and Rigging Work	0.3456	-0.3263	1.0176	-0.0064	-0.9432	0.9304
Non-Structural Interior Demolition	0.1552	-0.7990	1.1094	1.2241	-0.0561	2.5044
Ornamental & Fabricated Metal Installation	**0.7987**	**0.0052**	**1.5923**	0.5534	-0.6027	1.7094
Other Trade Work	**0.8730**	**0.0808**	**1.6651**	-0.2348	-1.3029	0.8334
Painting and Decorating	-0.3896	-1.1222	0.3431	-0.6662	-1.8985	0.5661
Piledriving Work	0.2706	-0.7990	1.3401	0.3913	-0.8145	1.5971
Plaster, Drywall and Acoustical Work	-0.0590	-0.6962	0.5782	0.0716	-0.8514	0.9945
Plumbing, Heating & Air Conditioning, Installation	0.3523	-0.2446	0.9492	0.0622	-0.8364	0.9608
Precast Concrete Installation	**1.1734**	**0.0006**	**2.3462**	0.5289	-1.3434	2.4012
Roof Shingling	0.3871	-0.3246	1.0988	0.2339	-1.0848	1.5526
Sheet Metal and Built-Up Roofing	0.1169	-0.5419	0.7758	0.3420	-0.6034	1.2873
Sheet Metal and Other Duct Work	-0.2726	-1.0295	0.4844	-0.1903	-1.2579	0.8772
Siding Work	0.4371	-0.2135	1.0877	0.4292	-0.5460	1.4044
Steel Reinforcing	-1.1712	-3.5713	1.2288	0.1690	-0.8312	1.1693
Structural Steel Erection	**1.5952**	**0.6110**	**2.5794**	1.1749	-0.0220	2.3717

	20-49 FTE			50+ FTE		
Parameter	**Estimate**	**Wald 95% Confidence Limits**		**Estimate**	**Wald 95% Confidence Limits**	
Terrazzo and Tile Work	0.4449	-0.3540	1.2438	0.2391	-0.9389	1.4171
Thermal Insulation Work	-0.5527	-1.3821	0.2767	-0.4981	-1.6752	0.6791
Wrecking and Structural Demolition	0.0064	-1.4778	1.4906	1.0946	-0.1515	2.3407
Postal code, first letter (ref: L)						
K	**0.1850**	**0.0072**	**0.3628**	0.0453	-0.1974	0.2881
M	-0.1182	-0.3040	0.0677	-0.0513	-0.2695	0.1669
N	0.0604	-0.1050	0.2258	**-0.2192**	**-0.4311**	**-0.0074**
P	**-0.2701**	**-0.5253**	**-0.0149**	-0.2491	-0.5925	0.0942
Other	0.2313	-0.0870	0.5496	-0.2386	-0.5081	0.0308
Complexity, number of CUs in company (ref: 1)						
2	0.0626	-0.0736	0.1988	-0.1092	-0.2913	0.0728
3	**0.4199**	**0.2204**	**0.6193**	-0.1419	-0.3668	0.0831
4	**0.5306**	**0.2655**	**0.7956**	0.1125	-0.1793	0.4043
5 or More	**0.6831**	**0.4030**	**0.9633**	-0.1247	-0.3833	0.1338
Dispersion	0.9311	0.8215	1.0552	1.0088	0.8940	1.1384
Goodness of Fit Statistics						
Akaike information criterion (AIC)	6810			5789		
Bayesian Information Criterion (BIC)	7076			6032		

Number of company-CUs (union, non-union): 20-49 FTE (816, 1,276), 50+ FTE (863, 456). Number of LTA claims (union, non-union): 20-49 FTE (1.145, 2.077); 50+ FTE (3.039, 2.003). Number of FTEs (union, non-union): 20-49 FTE (120,431, 169,211); 50+ FTE (541,983. 203,670).

Crude models

	0-4 FTE			5-19 FTE		
Parameter	**Estimate**	**Wald 95% Confidence Limits**		**Estimate**	**Wald 95% Confidence Limits**	
Intercept	**-4.2013**	**-4.2363**	**-4.1663**	**-4.1028**	**-4.1434**	**-4.0623**
Union (main independent variable)	-0.0958	-0.2507	0.0591	**-0.2876**	**-0.3836**	**-0.1916**
Dispersion	2.0297	1.8028	2.2852	1.2345	1.1318	1.3465
Goodness of Fit Statistics						
Akaike information criterion (AIC)	27853			18699		
Bayesian Information Criterion (BIC)	27879			18720		

Counts of company-CUs, claims and FTEs as in adjusted models.

	20-49 FTE			50+ FTE		
Parameter	**Estimate**	**Wald 95% Confidence Limits**		**Estimate**	**Wald 95% Confidence Limits**	
Intercept	**-4.3332**	**-4.4107**	**-4.2557**	**-4.4196**	**-4.5428**	**-4.2963**
Union (main independent variable)	**-0.2373**	**-0.3630**	**-0.1115**	**-0.4522**	**-0.6057**	**-0.2987**
Dispersion	1.1109	0.9891	1.2476	1.2202	1.0922	1.3632
Goodness of Fit Statistics						
Akaike information criterion (AIC)	6922			5848		
Bayesian Information Criterion (BIC)	6939			5864		

Counts of company-CUs, claims and FTEs as in adjusted models.

Appendix H: Detailed regression modeling results related to Table 4

This appendix presents the detailed regression results with LTA injury claims for the 14 models summarized in Table 4. Each page presents the results for two CUs, both adjusted and crude models.

Adjusted models

	Electrical Work			Excavating and Grading		
Parameter	**Estimate**	**Wald 95% Confidence Limits**		**Estimate**	**Wald 95% Confidence Limits**	
Intercept	-4.8390	-5.0623	-4.6156	-4.7842	-5.2267	-4.3416
Union (main independent variable)	-0.2875	-0.4446	-0.1305	-0.3643	-0.6464	-0.0822
Postal code, first letter (ref: L)						
K	-0.0108	-0.1788	0.1573	0.0959	-0.1879	0.3796
M	0.1589	-0.0292	0.3470	0.5138	0.0576	0.9700
N	-0.1349	-0.2993	0.0295	0.0809	-0.1796	0.3414
P	-0.2252	-0.4820	0.0316	0.2545	-0.0802	0.5892
Other	0.4605	0.1467	0.7743	-0.4926	-1.1948	0.2097
Complexity, number of CUs in company (ref: 1)						
2	0.0070	-0.1549	0.1688	-0.1078	-0.3761	0.1606
3	0.5159	0.2246	0.8073	0.0400	-0.3210	0.4009
4	0.3401	-0.1030	0.7831	0.3752	-0.0550	0.8055
5 or More	0.0429	-0.4370	0.5228	0.1727	-0.3783	0.7238
Firm size (ref: 50+ FTE)						
0-1 FTE	0.3339	0.0752	0.5926	0.2635	-0.2352	0.7622
2-4 FTE	0.1410	-0.1044	0.3864	0.2180	-0.2408	0.6768
5-19 FTE	0.3476	0.1308	0.5644	0.4538	0.0448	0.8629
20-49 FTE	0.2519	0.0062	0.4975	0.1122	-0.3203	0.5447
Dispersion	1.0120	0.8558	1.1967	0.9853	0.7303	1.3294
Goodness of Fit Statistics						
Akaike information criterion (AIC)	7726			2643		
Bayesian Information Criterion (BIC)	7840			2737		

Electrical Work (union, non-union): company-CUs (900, 8058); claims (740, 1812); FTEs (129,189, 177,425). Excavating & Grading (union, non-union): company-CUs (290,2386); claims (161, 552); FTEs (24,022, 48,250).

Crude models

	Electrical Work			Excavating and Grading		
Parameter	**Estimate**	**Wald 95% Confidence Limits**		**Estimate**	**Wald 95% Confidence Limits**	
Intercept	-4.5577	-4.6224	-4.4931	-4.3781	-4.4884	-4.2678
Union (main independent variable)	-0.3048	-0.4532	-0.1564	-0.4467	-0.7114	-0.1820
Dispersion	1.0650	0.9043	1.2544	1.0781	0.8135	1.4287
Goodness of Fit Statistics						
Akaike information criterion (AIC)	7743			2640		
Bayesian Information Criterion (BIC)	7764			2658		

Counts of company-CUs, claims and FTEs as in adjusted models.

Adjusted models

	Industrial Maintenance & Repair Contracting			Industrial, Commercial & Institutional Construction		
Parameter	**Estimate**	**Wald 95% Confidence Limits**		**Estimate**	**Wald 95% Confidence Limits**	
Intercept	-4.6262	-5.3871	-3.8653	-5.1068	-5.4354	-4.7782
Union (main independent variable)	-1.2577	-1.9489	-0.5665	-0.1972	-0.4134	0.0190
Postal code, first letter (ref: L)						
K	-0.6704	-1.6555	0.3147	0.3837	0.1354	0.6320
M	-0.1659	-1.2890	0.9572	-0.2710	-0.5578	0.0158
N	-0.3518	-0.9038	0.2003	0.5119	0.2993	0.7245
P	-0.2668	-1.1642	0.6307	0.0845	-0.2670	0.4360
Other	-0.7444	-1.3738	-0.1150	0.4643	0.0812	0.8474
Complexity, number of CUs in company (ref: 1)						
2	-0.0877	-0.6462	0.4709	0.1371	-0.0527	0.3270
3	0.1023	-0.6138	0.8184	0.4703	0.1885	0.7521
4	0.1701	-0.8425	1.1827	0.8156	0.3552	1.2760
5 or More	0.3221	-0.5508	1.1950	0.4400	0.0286	0.8514
Firm size (ref: 50+ FTE)						
0-1 FTE	-0.5411	-1.6748	0.5926	0.7113	0.3031	1.1196
2-4 FTE	0.0670	-0.7829	0.9169	0.5624	0.2194	0.9054
5-19 FTE	0.5148	-0.1597	1.1893	0.4500	0.1450	0.7551
20-49 FTE	0.3688	-0.3962	1.1338	0.0095	-0.3165	0.3355
Dispersion	1.0066	0.5878	1.7238	1.7122	1.4579	2.0108
Goodness of Fit Statistics						
Akaike information criterion (AIC)	658			4876		
Bayesian Information Criterion (BIC)	731			4974		

Industrial Maintenance & Repair Contracting (union, non-union): company-CUs (50,682); claims (44, 166); FTEs (21,665, 18,060). ICI Construction (union, non-union): company-CUs (513,2903); claims (454, 1158); FTEs (91,843, 114,855).

Crude models

	Industrial Maintenance & Repair Contracting			Industrial, Commercial & Institutional Construction		
Parameter	**Estimate**	**Wald 95% Confidence Limits**		**Estimate**	**Wald 95% Confidence Limits**	
Intercept	-4.6100	-4.8274	-4.3926	-4.3528	-4.4495	-4.2561
Union (main independent variable)	-1.2147	-1.8442	-0.5851	-0.3461	-0.5612	-0.1309
Dispersion	1.2601	0.7858	2.0206	1.9542	1.6797	2.2737
Goodness of Fit Statistics						
Akaike information criterion (AIC)	648			4937		
Bayesian Information Criterion (BIC)	662			4955		

Counts of company-CUs, claims and FTEs as in adjusted models.

Adjusted models

	Millwright & Rigging Work			Plumbing, Heating, & Air Conditioning, Installation		
Parameter	**Estimate**	**Wald 95% Confidence Limits**		**Estimate**	**Wald 95% Confidence Limits**	
Intercept	-4.5720	-5.2148	-3.9292	-4.6718	-4.8818	-4.4618
Union (main independent variable)	-1.1015	-1.5098	-0.6931	-0.4642	-0.6055	-0.3229
Postal code, first letter (ref: L)						
K	0.4107	-0.1850	1.0063	0.1643	0.0307	0.2979
M	-1.1973	-2.5033	0.1087	-0.0406	-0.1994	0.1181
N	0.2175	-0.2131	0.6481	-0.0148	-0.1461	0.1166
P	-0.3011	-0.8852	0.2830	0.0108	-0.1884	0.2100
Other	-0.1205	-0.6531	0.4122	-0.3136	-0.6981	0.0709
Complexity, number of CUs in company (ref: 1)						
2	-0.3046	-0.7693	0.1601	0.2272	0.1040	0.3503
3	0.1281	-0.4679	0.7241	0.3190	0.0735	0.5646
4	0.2264	-0.4795	0.9323	-0.2995	-0.7455	0.1465
5 or More	0.4170	-0.2220	1.0561	-0.2073	-0.6322	0.2176
Firm size (ref: 50+ FTE)						
0-1 FTE	0.0021	-0.9289	0.9331	0.3277	0.0878	0.5676
2-4 FTE	-0.1020	-0.8585	0.6544	0.4474	0.2258	0.6691
5-19 FTE	0.1221	-0.4211	0.6653	0.7127	0.5126	0.9128
20-49 FTE	0.8034	0.2961	1.3107	0.4151	0.1980	0.6323
Dispersion	0.9823	0.6615	1.4586	0.9191	0.8075	1.0461
Goodness of Fit Statistics						
Akaike information criterion (AIC)	1018			10627		
Bayesian Information Criterion (BIC)	1091			10742		

Millwright & Rigging Work (union, non-union): company-CUs (160,579); claims (116, 227); FTEs (33,637, 17,864). Plumbing, Heating, & Air Conditioning, Installation (union, non-union): company-CUs (783,8831); claims (983, 2924); FTEs (152,921, 188,701).

Crude models

	Millwright & Rigging Work			Plumbing, Heating, & Air Conditioning, Installation		
Parameter	**Estimate**	**Wald 95% Confidence Limits**		**Estimate**	**Wald 95% Confidence Limits**	
Intercept	-4.3104	-4.5003	-4.1205	-4.0848	-4.1368	-4.0328
Union (main independent variable)	-1.1017	-1.4581	-0.7452	-0.5434	-0.6770	-0.4099
Dispersion	1.0749	0.7312	1.5801	1.0121	0.8948	1.1449
Goodness of Fit Statistics						
Akaike information criterion (AIC)	1019			10716		
Bayesian Information Criterion (BIC)	1033			10737		

Counts of company-CUs, claims and FTEs as in adjusted models.

Adjusted model

	Sheet Metal & Built-Up Roofing		
Parameter	**Estimate**	**Wald 95% Confidence Limits**	
Intercept	-4.3165	-4.7463	-3.8867
Union (main independent variable)	-0.7301	-1.1213	-0.3388
Postal code, first letter (ref: L)			
K	-0.1707	-0.6409	0.2996
M	-0.1763	-0.5926	0.2401
N	0.0910	-0.2741	0.4560
P	0.4716	-0.0400	0.9831
Other	0.3807	-0.1815	0.9430
Complexity, number of CUs in company (ref: 1)			
2	0.0375	-0.2767	0.3518
3	0.0656	-0.3964	0.5275
4	0.2414	-0.3809	0.8636
5 or More	0.6436	-0.1404	1.4276
Firm size (ref: 50+ FTE)			
0-1 FTE	0.4211	-0.2546	1.0967
2-4 FTE	0.3762	-0.1211	0.8734
5-19 FTE	0.2770	-0.1272	0.6812
20-49 FTE	-0.2184	-0.6357	0.1990
Dispersion	0.5315	0.3499	0.8072
Goodness of Fit Statistics			
Akaike information criterion (AIC)	1133		
Bayesian Information Criterion (BIC)	1204		

Union, non-union: company-CUs (80,559); claims (149, 371); FTEs (21,994, 26,484).

Crude model

	Sheet Metal & Built-Up Roofing		
Parameter	**Estimate**	**Wald 95% Confidence Limits**	
Intercept	-4.0700	-4.2305	-3.9095
Union (main independent variable)	-0.8704	-1.2054	-0.5354
Dispersion	0.6565	0.4530	0.9514
Goodness of Fit Statistics			
Akaike information criterion (AIC)	1128		
Bayesian Information Criterion (BIC)	1141		

Counts of company-CUs, claims and FTEs as in adjusted models.

Appendix I: Hourly wages for the construction and construction trade contracting sectors, 2012-15 and 2017-18, by occupational group and firm size

a. All construction, 2012-2015

Firm size, all locations (number of FTEs)	Average hourly wage ($)				Ratio of hourly wages: trades unionized/ trades non-unionized
	Mgmt / professional	Other non-unionized	Trades, unionized	Trades, non-unionized	
Less than 20	30.63	20.69	29.92	20.29	1.5
20 to 99	33.88	24.94	30.51	22.80	1.3
100 or more	40.60	25.76	31.13	23.64	1.3

b. All construction, 2017-2018

Firm size, all locations (number of FTEs)	Average hourly wage ($)				Ratio of hourly wages: trades unionized/ trades non-unionized
	Mgmt / professional	Other non-unionized	Trades, unionized	Trades, non-unionized	
Less than 20	35.48	22.23	32.11	22.33	1.4
20 to 99	39.37	24.03	32.93	24.34	1.4
100 or more	43.67	25.89	34.48	25.32	1.4

c. Construction, trade contracting only, 2012-2015

Firm size, all locations (number of FTEs)	Average hourly wage ($)				Ratio of hourly wages: trades unionized/ trades non-unionized
	Mgmt / professional	Other non-unionized	Trades, unionized	Trades, non-unionized	
Less than 20	28.38	20.84	30.59	20.55	1.5
20 to 99	34.94	24.46	31.56	22.89	1.4
100 or more	45.89	25.04	31.79	24.01	1.3

Note on methodology

Data are a custom tabulation by IWH, using Statistics Canada's Labour Force Survey Public Use Microdata file, made available through the Data Liberation Initiative and the University of Toronto. The year 2016 is excluded because no occupational information was available for that year. Data were available for all construction sectors combined ("All construction") for 2012-2015 and 2017-2018; they

were also available for the construction sub-sector “trade contracting” for the 2012-2015 period only. Occupation was classified with a 47-categeory variable derived from National Occupational Classification - Statistics (NOC-S) 2001 for 2012-2015; and with a 40-category variable derived from NOC 2016 for 2017-2018 and IWH created a three-category occupational variable from these.

The “management/professional” category included occupations of senior managers; middle managers; other managers; professionals in business, natural/applied sciences, etc. The “other non-unionized” category included occupations in administrative and financial; distribution, tracking & scheduling coordination; technical; sales; and customer service. “Trades-union” and “trades-non-union” included occupations in electrical and construction trades; maintenance and equipment operation trades; transport and heavy equipment operation; trades helpers and construction labourers.